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ABSTRACT

This curriculum guide is intended to provide vocational teachers, supervisors, administrators, and counselors with a suggested model for organizing a course in electromechanical technology. Discussed first are the philosophy, purpose, and objectives of the course. Second, course admissions and recruitment procedures are outlined. Included in the next three sections are descriptions of occupations related to marketing and distributive education, descriptions of Dictionary of Occupational Titles (DOT) code exit points, a list of employability skills, and a task listing by DOT code. After an outline of the structure and content of the curriculum is presented, a series of user guide sheets are provided. Each of these contains some or all of the following: the task or unit competency addressed, a performance statement, suggested instructional activities, a list of instructional materials needed, estimated class hours, estimated lab hours, a performance objective, and suggested testing activities and resources. Examined next are facility requirements and procedures for the curriculum to serve various special needs students. The following instructional management information is included: guidelines for maintaining student competency records, procedures for criterion-referenced testing, and Georgia performance standards required for graduation. A glossary concludes the guide. (MN)

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ELECTROMECHANICAL TECHNOLOGY

SECONDARY CURRICULUM GUIDE

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ELECTROMECHANICAL TECHNOLOGY CURRICULUM GUIDE

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PURPOSE AND UTILIZATION OF THE CURRICULUM GUIDE

The purpose of this curriculum guide is to provide a suggested model for organizing vocational instructional content. In many cases, more material is available than may be needed, therefore, an instructor will need to adapt the content to meet his/her program needs.

While the guide is primarily oriented towards the classroom, whether as a primary resource or as a supplement to other teaching materials, it also assists administrators, counselors and lay people involved in local school systems. The following outline provides an overview of the various ways these groups may utilize the curriculum guides.

Vocational Teacher

-- Provide a guide for organizing their program of instruction,
-- Assist in establishing program objectives,
-- Serve as a curriculum materials resource guide,
-- Improve communications with employers and advisory committees
-- Facilitate competency based instruction,
-- Facilitate either group or self-paced instruction,
-- Include content by quarter and semester,
-- Cross-reference with existing state developed instructional materials.

Vocational Supervisors and Administrators

-- Assist in defining the scope and content of their programs,
-- Provide a means to improve curriculum management functions,
-- Serve as a guide for admissions and job placement functions,
-- Improve communications with employers and advisory committees.

Counseling and Guidance Staff

-- Provide a data base for counseling and guidance personnel,
-- Identify student exit points (career options),
-- Serve as guide for admissions and job placement,
-- Correlate with new State Board of Education graduation requirements,
-- Provide specific content sequencing by quarter and semester for student scheduling,
-- Provide curriculum options for the disadvantaged handicapped student, curriculum modifications for special needs students, and typical admission requirements for regular and special needs students.

Local Curriculum Coordination Committees

-- Serve as a guide in working out articulation arrangements,

-- Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

Vocational teachers, supervisors and administrators, counseling and guidance staff and local curriculum coordination committees will be primary users of this guide, however, the use of the guide is not limited to these groups, but by any and all groups directly related in designing a vocational curriculum.

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PHILOSOPHY, PURPOSE, AND OBJECTIVES

PHILOSOPHY, PURPOSE AND OBJECTIVES

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PHILOSOPHY, PURPOSE AND OBJECTIVES INTRODUCTION

This section provides an overview of the philosophies, purposes and goals for vocational education in the State of Georgia. These are applied to vocational education at the secondary level, however, it is recognized that more specific philosophies, purposes and goals will be applicable depending on the character of the local program.

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, high schools, postsecondary area vocational-technical schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recogized occupations.

SECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of secondary vocational education is to provide training opportunities to middle school students which are of sufficient variety and quality to enable them to make wise career choices, and at the high school level to become familiar with one or more occupations of interest and to specialize in a given occupation to the extent needed to acquire entry-level job skills and knowledge, or to enter more specialized training at the postsecondary level.

B. OBJECTIVES

1. At the middle school level, to provide exploratory PECE and Industrial Arts programs.

2. At the high school level, to provide:

a. Exploratory and prevocational Industrial Arts programs.
b. Prevocational programs in occupational clusters for entry into specialized programs in the 11th and 12th grades, or at the postsecondary level.
c. Training in a single occupational skill of sufficient depth to gain entry-level employability, or the option to continue specialized training at the postsecondary level.
d. Competency-based programs of occupational preparation which enable students to advance as far as possible through a planned sequence of courses leading to an occupational objective of greatest interest to the student.
e. Opportunities and activities for students to develop and improve affective skills needed for employment.
f. Vocational guidance, counseling, remedial and supportive programs and services needed by students to select and complete a program of vocational education.
g. Ancillary and supportive services necessary to ensure that all students have access to training opportunities regardless of race, sex, national origin, disadvantagement or handicap.
h. Opportunities for students to obtain or improve Home Economics and Consumer Education skills.
i. Vocational education programs such that 50% of those individuals who complete or leave a program of occupational preparation, and are available for employment, find employment in the field for which trained, or in a related field.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND GOALS FOR VOCATIONAL EDUCATION

(Insert your school's statement of philosophy, purpose and goals here.)

ADMISSIONS AND RECRUITMENT

ADMISSIONS AND RECRUITMENT

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ADMISSIONS AND RECRUITMENT INTRODUCTION

This section provides an overview of the admissions and recruitment process. Several legal regulations and nondiscriminatory information statements are provided to emphasize the promotion of nondiscriminatory practices in vocational education throughout Georgia.

ADMISSIONS AND RECRUITMENT*

ADMISSIONS

The role of vocational education is to provide individuals with high quality occupational training in order to become productive members of society's work force. It is the purpose of the admissions office and the instructor for each program to recruit and admit those persons who have the most reasonable chance for success. Acceptance of students into a program should be based on the physical, mental and educational qualifications required for the program and the job.

Legal Aspects

Admission to a vocational program should not be denied on the basis of race, national origin, color, creed, sex or handicap. Instructors must be able to explain career options to these individuals. It is also important for the instructor to be able to explain federal laws and regulations which govern nondiscriminatory practices in education and on the job. Several important regulations are shown below.

- .Title VI - Civil Rights Act of 1964 (nondiscrimination on the basis of race, color and national origin)
- .Title IX - Educational Amendments of 1972 (nondiscrimination on the basis of sex)
- .Section 504 of the Rehabilitation Act of 1973 (nondiscrimination on the basis of handicap)
- .Guaranteed Loan Program of 1975
- .Equal Pay Act of 1963

Nondiscriminatory Information

The following items are being implemented in Georgia vocational schools to promote nondiscriminatory practices.

- .no student may be denied service, financial aid or other benefits on the grounds of race, color, sex, national origin, or handicap
- .no student may be treated differently from others in determining admission, enrollment, or eligibility in order to be provided any service, financial aid or other benefits
- .males, females, minorities, and handicapped persons should be portrayed in both leadership and student roles
- .males, females, minorities, and handicapped persons should be portrayed in nontraditional occupations
- .emphasize that employers are required by law to employ without regard to

race, color, creed, national origin, sex or handicapping conditions

- exclusion of persons on the basis of parental, family or marital status, pregnancy, childbirth, termination of pregnancy or recovery therefrom is prohibited

- avoidance of subtle or open bias against any individual or group of individuals

- limitations on the number or proportion of persons of either sex admitted to a program is prohibited

- use of sex-fair language (i.e. Avoid using masculine pronouns when generalizing about a group. Replace "he" or "she" with "student".)

- school's willingness and ability to service the handicapped with programs and activities

- the availability of special services for handicapped students

Job Placement

The school's job placement office should make accessible to students information regarding the nature of the job market, working conditions and salary expectations. The Occupational Information section of this Curriculum Guide will provide additional information in this area.

Student Records

Students records are maintained to provide students and instructors with a base to identify student strengths and weaknesses for placement into a program. Student records are also made available to other educational institutions or potential employers. The student record contains all information applicable to each student such as the application for admissions, medical records, transcripts, etc.

The Family Educational Rights and Privacy Act of 1974 allows the schools to disclose information about a student only if the student has been given the opportunity to refuse disclosure. Students have the right to the access of their personal records, however, students are not allowed to inspect certain types of confidential information related to their record or file. Related information which is not available to the student includes such items as parent's financial information, job placement records or records of law enforcement agencies.

Students records are confidential and are generally stored in a limited access storage area. It should also be explained to the student that some Federal and state agencies are allowed access to the student records without their consent.

RECRUITMENT

The purpose of the recruitment process is to market vocational education and its programs. The goal of recruitment is to search for and identify potential students who want and need vocational education and then to familiarize them with the vocational programs available to them. Recruitment is a team effort; every staff member and student has the potential to be a recruiter.

The recruitment process is composed of three phases: research, planning and promotion.

Research

Before planning and promoting a recruitment program, each vocational program must conduct a self-evaluation. The following represent items which vocational programs should consider in the research phase of the recruitment process.

.Who constitutes our target population?

.Why do students choose a vocational program?

.Why don't students choose a vocational program?

.Once enrolled, why do students stay in a vocational program?

.What is our public image among?

-- students
-- parents
-- employers
-- general public

.Are vocational students used to assist in the recruitment for low enrollment programs?

.What recruitment techniques do current vocational students consider effective?

.How can we market programs with low enrollment more effectively?

.What are the vocational program's major strengths?

.What are the vocational program's major weaknesses?

.What are the vocational program's major strengths in facilities?

.What are the vocational program's major weaknesses in facilities?

Planning

The planning phase of the recruitment process addresses deficiencies revealed by the research process. EXAMPLE: The research process identified that existing facilities are not accessible to the handicapped. In the planning phase, efforts are made to modify the existing facilities for accessibility by handicapped students.

Promotion

Promotion, the last phase of recruitment, is the most time consuming part of the process. This phase consists of generating, organizing and communicating recruitment ideas.

The following examples represent types of promotional activities which you may find beneficial with recruiting for vocational programs.

1. Interacting with General Advisory Committee

Typically, general advisory committee members are influential in business and industry and are community leaders. Information gleaned from this committee is invaluable because these people are familiar with recent trends and changing conditions in industry and in the economy. Members of protected populations should be actively sought to serve on the general advisory committee so that the entire community can have input into vocational programs. Because of their position as community leaders, craft committee members from protected populations can also serve as a recruitment function in their community, thereby improving vocational programs' opportunity to serve a broader segment of society.

2. Interacting with Craft Committees

Since members of craft committees generally have contact with a large number of potential students, interaction with these individuals is an important part of any recruitment effort. Individuals from protected populations should be encouraged to serve on craft committees so that they can become aware of the equal opportunity afforded to all students in vocational programs.

3. Designing Vocational Program Recruitment Publications

Publications such as vocational program catalogs, brochures and audiovisual presentations are excellent methods of promoting vocational programs. When designing publications, it is essential to include a variety of students from different races, colors, ages, sexes and handicapping conditions in illustrations, drawings, slides or film. The students illustrated should be involved in a broad range of occupational programs with an emphasis on nontraditional career opportunities available through vocational programs.

4. Open House

Schedule open house activities to allow the general public to meet the vocational staff and students and to learn more about the available vocational programs. The open house should be publicized as far in advance as possible. Media announcements and articles should be distributed so as to reach the broadest segment of the population, including women, minorities and members of limited English speaking communities.

Using student tour guides is an effective recruitment method since prospective students often find it easier to develop rapport with another student rather than a vocational staff member.

5. Visiting Local Business and Industry

It is important to inform employers that the vocational atmosphere encourages students to pursue the career of their choice. Employers must be assured that the vocational staff will send them the best qualified applicants for a position regardless of race, color, age, sex, national origin or handicap.

6. Civil, Social and Community Presentations

Opportunities to speak with service groups, church groups and other community organizations which represent a broad range of individuals should be made. In addition to addressing civic groups traditionally served in the past, new and emerging interest groups in the service area should be addressed.

7. Recruitment Day

Recruitment day provides students and parents an opportunity to visit vocational programs and obtain first hand information about vocational education.

8. Newspaper Coverage

Reports on vocational activities and student success stories sent to local newspapers help bring vocational programs to the attention of the general public. Newspapers are generally receptive to publishing articles and reports written by the vocational staff or students. Whenever possible, features and photographs sent to the press should include students of both sexes and members of minority groups. Students in nontraditional occupational roles should also be highlighted in feature stories prepared for the press.

9. Radio and Television Coverage

As part of their public service functions, local radio and television stations have been willing to provide schools and vocational programs with time and coverage of noteworthy events. This coverage takes the form of spot announcements during Vocational Education Week, Open House or prior to other special events.

10. Direct Mail

Sending information to targeted groups with an enclosed reply card has proven to be quite useful. Any direct mailings used for recruitment should include vocational program's nondiscriminatory policy statement and stress nontraditional career opportunities.

11. Billboards

Sometimes outdoor advertising on local billboards can be an effective recruitment device provided the cost is not prohibitive. Whenever billboard advertising is used, vocational programs should be presented in a positive manner.

Considerations when Evaluating Recruitment

The following items should be considered when evaluating the promotional aspect of the recruitment effort.

- .Is the recruitment plan or activity organized?
- .Are the materials used free of discrimination or bias?
- .Are students recruited into vocational programs which are usually considered to be nontraditional for their sex, race, national origin, color, age or handicap?
- .Do recruitment teams include persons of different sexes, races, national origins, colors, ages or handicaps?
- .Do promotional activities stress that each vocational program is available to both male and female students?
- .Is the promotional material provided to the limited English speaking community in their native language?
- .Does promotional material indicate that vocational programs are open to all students regardless of sex, race, national origin, color, age or handicap?
- .Does the recruitment program reach all protected populations?

*Abstracted from: Georgia Department of Education, Admissions Guide and Testing Guide. AEC. Pittsburgh, Pennsylvania. 1982.

OCCUPATIONAL INFORMATION

OCCUPATIONAL INFORMATION

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OCCUPATIONAL INFORMATION INTRODUCTION

This section provides an overview of the Electromechanical Technology field. Also included are specific job information and various characteristics pertinent to the D.O.T. exit points which can potentially be achieved in this Electromechanical Technology curriculum guide.

DESCRIPTION OF THE OCCUPATION

ELECTRICAL-APPLIANCE PREPARER - 827.584-010*
HOUSEHOLD-APPLIANCE INSTALLER - 827.661-010*
ELECTRICAL-APPLIANCE SERVICER - 827.261-010*
GAS-APPLIANCE SERVICER HELPER - 637.684-010*

Nature of the Work

Most household chores such as cooking and cleaning used to be performed by hand and often involved a great deal of time and physical effort. Today, a variety of laborsaving appliances make many household jobs much simpler to do. Microwave ovens cook meals in minutes. Washers and dryers clean clothes with little physical effort. Indeed, the number of household jobs machines can do is almost limitless. Even simple tasks such as cooking a hamburger or opening a can are done with appliances made specifically for those purposes. Servicing these machines is the job of the appliance repairer.

Appliance repairers usually specialize in servicing either portable appliances such as toasters and vacuum cleaners or major appliances such as refrigerators, freezers, washers, and dryers. Repairers in large shops generally are more specialized than those in small shops.

Major appliances usually are repaired in customers' homes by appliance repairers who carry their tools and a number of commonly used parts with them in a truck.

To determine why an appliance is not working properly, repairers operate it to detect unusual noises, overheating, or excess vibration. They look for common sources of trouble, such as faulty electrical connections, and consult service manuals and troubleshooting guides. They may disassemble the appliance to examine its parts. To check electric systems, repairers follow wiring diagrams and use testing devices, such as ammeters, voltmeters, and wattmeters.

After locating the trouble, the repairer makes the necessary repairs or replacements according to the type of appliance and defect involved. To fix a major appliance such as a washer, the repairer may replace worn bearings, transmission belts, or gears. To remove old parts and install new ones, repairers use common handtools, including screwdrivers, soldering irons, files, pliers, and special tools designed for particular appliances. Repairers operate the appliance after completing a repair to check their work.

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*Occupational Outlook Handbook. Washington: U.S. Department of Labor, 1982-83.

Appliance repairers may estimate and collect the cost of repairs. They also keep records of parts used and hours worked on each job.

Working Conditions

Repair shops generally are quiet, well lighted, and adequately ventilated. Working conditions outside the shop vary. For example, repairers sometimes work in narrow spaces and uncomfortable positions amidst dirt and dust. Those who repair appliances in homes may spend several hours a day driving.

Although the work generally is safe, repairers could have an accident while handling electrical parts and lifting and moving large appliances. Inexperienced workers are shown how to use tools safely and how to avoid electric shock.

Appliance repairers usually work with little or no direct supervision. This feature of the job appeals to many people.

Employment

About 77,000 people were employed as appliance repairers in 1980, many in independent appliance stores and repair shops. Others worked for service centers operated by appliance manufacturers, department stores, wholesalers, and gas and electric utility companies.

Appliance repairers are employed in almost every community, but are concentrated in the more highly populated areas.

Training, Other Qualifications, and Advancement

Appliance repairers learn their trade on the job. Many repairers have completed formal training in appliance repair and related subjects in high schools, private vocational schools, and community colleges. The programs in these schools provide the background in electrical and mechanical repair that is needed to enter this occupation. However, graduates usually need additional training from their employer.

The type of training provided by employers varies among companies. In companies that repair major appliances, beginners may be trained by experienced repairers during house calls. In other cases, they are taught while working in the shop rebuilding used parts such as washing machine transmissions. Up to 3 years of on-the-job training may be needed to become skilled in all aspects of repairing some of the more complex appliances.

Some large companies such as appliance manufacturers and department store chains have formal training programs, which include home study courses and shop classes, where trainees work with demonstration appliances and other training equipment.

Many repairers receive supplemental instruction through seminars that are conducted periodically by appliance manufacturers. These seminars usually last 1 or 2 weeks and deal with the repair of one of the manufacturer's appliances. To become familiar with new appliances and the proper ways to repair them, experienced repairers attend training classes or study service manuals.

Persons who want to become appliance repairers generally must have a high school diploma. Courses in electronics are essential because most repairs involve work with electrical equipment. Appliance repairers who work in customers' homes must be courteous and tactful.

Appliance repairers in large shops or service centers may be promoted to supervisor, assistant service manager, or service manager. A few may advance to managerial positions such as regional service manager or parts manager for appliance manufacturers. Preference is given to those who show ability to get along with co-workers and customers. Experienced repairers who have sufficient funds may open their own appliance stores or repair shops.

Job Outlook

Employment of appliance repairers is expected to grow about as fast as the average for all occupations through the 1980's. In addition to the jobs created by increased demand for appliance repairers, many openings will arise each year from the need to replace experienced repairers who transfer to other occupations, retire, or die.

The number of appliances in use is expected to increase very rapidly as the number of households grows and new and improved appliances are introduced. While modern appliances generally require less service than older models, maintaining the large number of appliances will generate demand for qualified repairers. Because electronic parts are increasingly used in modern appliances, repairers with a strong background in electronics should have the best job prospects.

People who enter the occupation should have steady work because the demand for appliance repair services continues during economic downturns.

Related Occupations

Other workers who service electrical and electronic equipment include air-conditioning mechanics, bowling-pin-machine mechanics, business machine repairers, electric sign repairers, electronic organ technicians, television and radio repairers, and vending machine mechanics.

Sources of Additional Information

For further information about jobs in the appliance service field, contact local appliance repair shops, appliance dealers and utility companies, or the local office of the State employment service.

Information about training programs or work opportunities also is available from: Association of Home Appliance Manufacturers, 20 N. Wacker Dr., Chicago, IL 60606.

ELECTRICIAN - 824.261-010*
ELECTRICIAN HELPER - 829.684-022*
ELECTRICIAN APPRENTICE - 824.261-014*
ELECTRICIAN - 824.681-010*
ELECTRICAL REPAIRER - 829.281-014*

Nature of the Work

Heating, lighting, power, air-conditioning, and refrigeration components all operate through electrical systems that are assembled, installed, and wired by electricians. These workers also install electrical machinery, electronic equipment and controls, and signal and communications systems.

Electricians follow blueprints and specifications for most installations. To install wiring in factories and offices, they may bend, fit, and fasten conduit (pipe or tubing) inside partitions, walls, or other concealed areas. Workers also fasten to the wall small metal boxes that will house electrical devices such as switches.

To complete circuits between outlets and switches, they then pull insulated wires or cables through the conduit. They work carefully to avoid damaging any wires or cables. In lighter construction, such as housing, plastic-covered wire usually is used rather than conduit. In any case, electricians connect the wiring to circuit breakers, transformers, or other components. Wires are joined by twisting ends together with pliers and covering the ends with special plastic connectors. When additional strength is desired, they may use an electric "soldering gun" to melt metal on to the twisted wires, then cover them with durable, electrical tape. When the wiring is finished, they test the circuits for proper connections.

For safety, electricians follow National Electrical Code specifications and procedures and, in addition, must comply with requirements of State, county, and municipal electrical codes.

Electricians generally furnish their own tools, including screwdrivers, pliers, knives, and hacksaws. Employers furnish heavier tools, such as pipe threaders, conduit benders, and most test meters and power tools.

Working Conditions

Electricians are not required to have great physical strength, but they frequently must stand for long periods and work in cramped quarters. Because much of their work is indoors, electricians are less exposed to unfavorable weather than most other construction workers are. They may risk electrical shocks, falls from ladders and scaffolds, and blows from falling objects. However, safety practices have reduced the injury rate.

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*Occupational Outlook Handbook. Washington: U.S. Department of Labor, 1982-83.

Employment

Over 290,000 electricians were employed in 1980. Most worked for electrical contractors; others were self-employed contractors. Like the general population, electricians are concentrated in industrialized and urban areas.

Training, Other Qualifications, and Advancement

Most training authorities recommend the completion of a 4-year apprenticeship program as the best way to learn the electrical trade. Compared to most other construction trades, electricians have a higher percentage of apprentice-trained workers. Although many people learn the trade informally by working for several years as electricians' helpers, this method of training is declining in relative importance. Many helpers gain additional knowledge through technical school or correspondence courses, or through special training in the Armed Forces.

Apprenticeship programs are sponsored through and supervised by local union-management committees or by company management committees. Although the programs are separate, the content, training, and method of instruction are nearly identical. These programs provide 144 hours of classroom instruction each year in addition to comprehensive on-the-job training. In the classroom, apprentices learn blueprint reading, electrical theory, electronics, mathematics, and safety and first-aid practices. On the job, under the supervision of experienced electricians, apprentices must demonstrate mastery of electrical principles. At first, apprentices drill holes, set anchors, and set up conduit. Later, they measure, bend, and install conduit, as well as install, connect, and test wiring. They also learn to set up and draw diagrams for entire electrical systems.

Beginners who are not apprentices can pick up the trade informally in a variety of ways. For example, some begin work in manufacturing plants by piecing together electrical components. Others start in maintenance where they learn about circuit breakers, fuses, switches, and other electrical devices. Later, they broaden their knowledge by working as helpers for experienced electricians. While learning to install conduit, connect wires, and test circuits, helpers are also taught safety practices.

All applicants should be in good health and have at least average physical strength. Also important are agility and dexterity. Good color vision is important because workers frequently must identify electrical wires by color. Applicants for apprentice positions must be at least 18 years old and usually must be a high school or vocational school graduate with

1 year of algebra. Courses in electricity, electronics, mechanical drawing, science, and shop provide a good background.

To obtain a license, necessary for employment in some localities, an electrician must pass an examination which requires a thorough knowledge of the craft. Familiarity with the National Electric Code and with local electric and building codes is important.

Experienced electricians can advance to supervisors, superintendents, or contract estimators for contractors on construction jobs. Many electricians start their own contracting businesses. In many areas, a contractor must have an electrical contractor's license.

Job Outlook

Employment of electricians is expected to increase about as fast as the average for all occupations through the 1980's. As population and the economy grow, more electricians will be needed to install electrical fixtures and wiring in new and renovated homes, offices, and other buildings. In addition to jobs created by increased demand for electrical work, many openings will arise as experienced electricians leave the occupation, retire, or die.

Although employment in this field is expected to grow over the long run, it may fluctuate from year to year due to ups and downs in construction activity. Some electricians may be laid off when the level of construction declines. When construction jobs are not available, however, some workers may transfer to jobs as maintenance electricians in industries that are less sensitive to cyclical swings in the economy than the construction industry.

Job opportunities may be more favorable in the South and West than in other regions of the Nation. Graduates of apprenticeship programs should have the best prospects for employment.

Related Occupations

To install electrical systems, electricians combine manual skill and a knowledge of electrical materials and concepts. Other occupations involving similar skills include air-conditioning mechanics, cable installers and repairers, electronics mechanics, elevator constructors, and maintenance electricians.

Sources of Additional Information

For details about electrician apprenticeships or other work opportunities in this trade, contact local electrical contractors; a local chapter of the Independent Electrical Contractors, Inc.; a local chapter of the National Electrical

Contractors Association; a local union of the International Brotherhood of Electrical Workers; a local union-management apprenticeship committee; or the nearest office of the State employment service or State apprenticeship agency. Some local employment services offices screen applicants and give aptitude tests.

For general information about the work of electricians, contact: Independent Electrical Contractors, Inc., 1101 Connecticut Avenue, N.W., Suite 700, Washington, D.C. 20036; International Brotherhood of Electrical Workers, 1125 15th Street, N.W., Washington, D.C. 20005; National Association of Lighting Maintenance Contractors, 313 Price Place, Suite 110, Madison, WI 53705; National Electrical Contractors Association, 7315 Wisconsin Avenue, Bethesda, MD 20814; National Joint Apprenticeship and Training Committee for the Electrical Industry, 9700-E George Palmer Hwy., Lanham, MD 20706.

REFRIGERATION MECHANIC HELPER - 637.687-014*
AIR-CONDITIONING INSTALLER-SERVICER, WINDOW UNIT - 637.261-010*
AIR-CONDITIONING INSTALLER-SERVICER HELPER, WINDOW UNIT -
637.687-010*
REFRIGERATOR TESTER - 827.384-010*
GAS LEAK TESTER - 827.584-014*

Nature of the Work

People always have sought ways to make their environment more comfortable. Today air-conditioning systems control the temperature, humidity, and even the cleanliness of the air in homes, offices, factories, and schools. In addition, refrigeration systems make it possible to safely store food, drugs, and other perishable items. Air-conditioning and refrigeration mechanics are skilled workers who install, test, maintain, and repair such systems. They may be assisted by "helpers" in performing their job duties.

Air-conditioning or refrigeration requires more than a single machine. In central air-conditioning systems, for example, fans, compressors, condensers, and evaporators cool and dehumidify the air. Metal ducts or special piping distribute the treated air throughout the building. Mechanics must be able to work with the complete system--the ducts and pipes as well as all the machinery.

Mechanics may specialize in installation or in service--maintenance and repair. Some work only with certain equipment such as commercial refrigerators. However, mechanics may do both installation and service and work with cooling and refrigeration equipment. The following are some specific jobs in this field.

Job responsibilities include installing and servicing air-conditioning systems and a variety of refrigeration equipment. For air-conditioning or refrigeration systems, mechanics follow blueprints, design specifications, and manufacturers' recommended procedures to install motors, compressors, condensing units, evaporators, and other components. They connect this equipment to the duct work, refrigerant lines, and electrical power source. After making the connections, they charge the system with refrigerant if necessary and check it for proper operation.

When air-conditioning and refrigeration equipment breaks down, mechanics diagnose the cause and make repairs. To find defects they test parts such as compressors, relays, and thermostats. During the winter, air-conditioning mechanics inspect the systems and perform maintenance, such as overhauling compressors. Some air-conditioning and refrigeration mechanics also service heating systems.

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*Occupational Outlook Handbook. Washington: U.S. Department of Labor, 1982-83.

They use a variety of tools including hammers, wrenches, metal snips, electric drills, pipe cutters and benders, and acetylene torches, to work with refrigerant lines and air ducts. They use volt-ohmmeters, manometers, and other testing devices to check electrical circuits, burners, and other components.

Working Conditions

Mechanics work in homes, office buildings, factories--anywhere there is climate control equipment. They carry their tools and some spare parts to the job sites in trucks that often are equipped with two-way radios. For major repairs mechanics transport broken machinery or parts to the repair shop.

Mechanics may work outside or inside. Mechanics often work in awkward or cramped positions and sometimes are required to work in high places. Other hazards in this trade include electrical shock, torch burns, muscle strains, and other injuries from handling heavy equipment.

Employment

Approximately 179,000 persons worked as air-conditioning and refrigeration mechanics in 1980. Cooling and heating contractors employed most air-conditioning and refrigeration mechanics. They also work for foodstore chains, school systems, manufacturers, and other organizations that operate large air-conditioning and refrigeration systems. Approximately 1 out of 6 mechanics is self-employed.

Air-conditioning and refrigeration mechanics work in all parts of the country. Generally, the geographic distribution of these workers is similar to that of the population.

Training, Other Qualifications, and Advancement

Most air-conditioning and refrigeration mechanics start as helpers and acquire their skills by working for several years with experienced mechanics. New workers usually begin by assisting experienced mechanics and doing simple jobs. They may carry materials, insulate refrigerant lines, or clean furnaces. In time, they do more difficult jobs, such as cutting and soldering pipes and sheet metal and checking electrical circuits. In 4 or 5 years new mechanics are capable of doing all types of repairs and installations.

Many high schools, private vocational schools, and junior colleges offer programs in air-conditioning and refrigeration. Students study air-conditioning and refrigeration theory and the design and construction of the equipment. They also learn the basics of installation, maintenance, and repair. Although completion of such a program does not assure a job, employers may prefer to hire graduates of these programs because they require less on-the-job training.

Apprenticeship programs are run by unions and air-conditioning contractors. In addition to on-the-job training, apprentices receive 144 hours of classroom instruction each year in related subjects, such as the use and care of tools, safety practices, blueprint reading, and air-conditioning theory. Applicants for apprenticeships must have a high school diploma and pass a mechanical aptitude test. Apprenticeships last 4 years.

When hiring helpers, employers prefer high school graduates with mechanical aptitude who have had courses in mathematics, mechanical drawing, electricity, physics, and blueprint reading. Good physical condition also is necessary because workers sometimes have to lift and move heavy equipment.

To keep up with changes in technology and to expand their skills, experienced mechanics may take courses offered by associations such as the Refrigeration Service Engineers Society, the Petroleum Marketing Education Foundation, and the Air-Conditioning Contractors of America.

Mechanics can advance to positions as supervisors. Those with sufficient money and managerial skill can open their own contracting businesses.

Job Outlook

Employment of air-conditioning and refrigeration mechanics is expected to increase about as fast as the average for all occupations through the 1980's. Many openings will occur as experienced mechanics transfer to other fields of work, retire, or die.

Employment of air-conditioning and refrigeration mechanics will increase as more homes and commercial and industrial buildings are constructed. Installations of new energy-saving air-conditioning and refrigeration systems in existing homes and buildings also will increase employment of mechanics.

Because these trades have attracted many people, beginning mechanics may face competition for jobs as helpers or apprentices. Graduates of training programs that emphasize hands-on experience will have an advantage in getting a job.

Employment of air-conditioning and refrigeration mechanics usually is not sensitive to downturns in the economy because maintenance of existing systems and installation of new, more efficient equipment in existing buildings make up a large part of their work. Because people and businesses depend on their air-conditioning and refrigeration systems, the need for mechanics to do maintenance work is strong even during economic downturns.

Related Occupations

Air-conditioning and refrigeration mechanics work with sheet metal and piping, and repair machinery, such as electrical motors, compressors, and burners. Other workers who have similar skills are boilermakers, electrical appliance servicers, electricians, pipefitters, plumbers, and sheet metal workers.

Sources of Additional Information

For more information about employment and training opportunities in this trade, contact local air-conditioning and refrigeration contractors; a local of the union previously mentioned; a local joint union-management apprenticeship committee; or the nearest office of the State employment service or State apprenticeship agency.

For pamphlets on career opportunities and training, write to: Air-Conditioning and Refrigeration Institute, 1815 N. Fort Myer Drive, Arlington, VA 22209 (The Institute prefers not to receive individual requests for large quantities of pamphlets.) or Air-Conditioning Contractors of America, 1228 17th Street, N.W., Washington, D.C. 20036.

MAINTENANCE MECHANIC HELPER - 638.684-018*
MAINTENANCE REPAIRER HELPER - 899.684-022*
PNEUMATIC TOOL REPAIRER - 630.281-010*
ELECTROMECHANICAL TECHNICIAN - 710.281-018*
ELECTRONIC-PRODUCTION-LINE MAINTENANCE MECHANIC - 629.281-022*

Nature of the Work

When a machine breaks down in a plant or factory, not only is the machine idle, but raw materials and human resources are wasted. It is the industrial machinery repairer's job to prevent these costly breakdowns and to make repairs as quickly as possible.

Industrial machinery repairers--often called maintenance mechanics--spend much time doing preventive maintenance. This includes keeping machines well oiled and greased, and periodically cleaning parts. The repairer regularly inspects machinery and checks performance. Tools such as micrometers, calipers, and depth gauges are used to measure and align all parts. For example, treadles on sewing machines in the apparel industry may need adjustment and gears and bearings may have to be aligned. By keeping complete and up-to-date records, mechanics try to anticipate trouble and service machinery before the factory's production is interrupted.

When repairs become necessary, the maintenance mechanic must first locate the specific cause of the problem. This challenge requires knowledge reinforced by experience. For example, after hearing a vibration from a machine, the mechanic must decide whether it is due to worn belts, weak motor bearings, or any number of other possibilities. Repairers often follow blueprints and engineering specifications in maintaining and fixing equipment.

After correctly diagnosing the problem, the maintenance mechanic disassembles the equipment, and then repairs or replaces the necessary parts. Hand and power tools usually are needed. The repairer may use a screwdriver and a wrench to take the door off an oven, or a crane to lift a printing press off the ground. Electronic testing equipment often is included in the mechanic's tools. Repairers use catalogs to order replacements for broken or defective parts. When parts are not readily available, or when a machine must be quickly returned to production, repairers may sketch a part that can be fabricated by the plant's machine shop.

The repairer reassembles and tests each piece of equipment after it has been serviced, for once it is back in operation, the machine is expected to work as if it were new.

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*Occupational Outlook Handbook. Washington: U.S. Department of Labor, 1982-83.

Working Conditions

Industrial machinery repairers are not usually affected by seasonal changes in production. During slack periods, when some plant workers are laid off, repairers often are retained to do major overhaul jobs. In addition to their regular work schedule, industrial machinery repairers may be called to the plant at night or on weekends for emergency repairs.

Repairers may work in stooped or cramped positions to reach the underside of a generator, for example. They also may work from the top of ladders when repairing a large machine. These workers are subject to common shop injuries such as cuts and bruises. Goggles, metal-tip shoes, safety helmets, and other protective devices help prevent injuries.

Placement of Employment

Industrial machinery repairers work in almost every industry in which a great deal of machinery is used. Many of the 655,000 repairers employed in 1978 worked in the following manufacturing industries: Food products, primary metals, machinery, transportation equipment, paper, and rubber.

Because industrial machinery repairers work in a wide variety of plants, they are employed in every section of the country. Employment is concentrated, however, in heavily industrialized areas.

Training, Other Qualifications, and Advancement

Graduation from high school is preferred, but not always required, for entry into this occupation. High school courses in mechanical drawing, mathematics, blueprint reading, and physics are useful for those interested in entering this trade.

Most workers who become industrial machinery repairers start as helpers and pick up the skills of the trade informally. Some learn the trade through apprenticeship programs. Apprenticeship training usually lasts 4 years and consists of on-the-job training and related classroom instruction in subjects such as shop mathematics, blueprint reading, welding, and safety.

Mechanical aptitude and manual dexterity are important qualifications for workers in this trade. Good physical condition and agility are also necessary because repairers sometimes have to lift heavy objects or climb to reach equipment located high above the floor.

Examinations may be administered periodically to determine the repairer's ability to maintain more advanced machinery. Some repairers are promoted to machinists or tool-and-die makers or become master mechanics.

Employment Outlook

Employment of industrial machinery repairers is expected to increase much faster than the average for all occupations through the 1980's. More repairers will be needed as manufacturers invest in more industrial machinery. Also, as machinery becomes more complex, repair work and preventive maintenance will become more time consuming. In addition, many openings will result from the need to replace repairers who retire, die, or transfer to other occupations.

Related Occupations

Other occupations which involve repairing machinery include: Aircraft mechanics, automobile mechanics, bowling-pin-machine mechanics, machinists, millwrights, tool-and-die makers, and vending machine mechanics.

Sources of Additional Information

Information about employment and apprenticeship opportunities in this field may be available from local offices of the State employment service or the following organizations: International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America, 8000 East Jefferson Avenue, Detroit, MI 48214 and International Union of Electrical, Radio and Machine Workers, 1126-16th Street, N.W., Washington, D.C. 20036.

FLUID POWER MECHANIC - 600.281-010*

Nature of the Work

All-round machinists, including the category of fluid power mechanics, are skilled metalworkers who can turn a block of metal into an intricate part, such as a gear or piston, that meets precise specifications. They know how to set up and operate most types of machine tools used to make metal parts for aircraft, cars, machines, and other equipment. They also know the working properties of metals such as steel, cast iron, aluminum, and brass used to make these parts. Using this knowledge of metals plus their skill with machine tools, production machinists plan and carry out the operations needed to make a machined product.

Before they begin work on a part, machinists usually consult blueprints or written specifications. They select tools and materials for the job and plan the cutting and finishing operations. To make a rifle barrel, for example, they might use alloy steel for the workpiece and a boring machine to cut out the rifle bore. After selecting a workpiece and the appropriate machine, they determine dimensions of work and machining computations. For example, they must know where to bore the hole in the workpiece, how fast they can feed the metal workpiece into the machine, and which cooling oils keep metal from overheating.

They use precision instruments, such as micrometers, to check their work to thousandths or even ten-thousandths of an inch. After completing machining operations, they may smooth rough metal edges before assembling the finished parts.

Like production machinists, all-round machinists in maintenance shops have a broad knowledge of metals, machines, and machining operations. These workers repair or make new parts for machinery. They also adjust and test these parts.

Working Conditions

The work environment for machinists has improved considerably in recent years. Most machine shops are clean, well lighted, and well ventilated. Many modern shops are air-conditioned. Noise levels also have been reduced with the introduction of better designed machine tools. In shops where noise still is a problem, workers must wear earmuffs or earplugs to protect their hearing.

Working around high-speed machine tools, however, can still present certain dangers. Because flying pieces of hot metal can cause burns and cuts, machinists must wear safety glasses with side shields and other protective devices. Loose or billowy clothing, long hair, and rings or other jewelry are prohibited.

*Occupational Outlook Handbook. Washington: U.S. Department of Labor, 1982-8[illegible].

Employment

About 303,000 persons worked as machinists in 1980. Almost every factory that uses substantial amounts of machinery employs all-round machinists to maintain its mechanical equipment. In some factories, machinists make large quantities of identical parts such as automobile axle shafts in production departments. In others, they make limited numbers of varied products such as missile motor cases in machine shops.

Most all-round machinists work in the following industries: Machinery, including electrical; transportation equipment; fabricated metal products; and primary metals. Other industries employing substantial numbers of these workers are the railroad, chemical, food processing, and textile industries. The Federal Government also employs all-round machinists in Navy yards and other installations.

Although machinists work in all parts of the country, jobs are most plentiful in areas where many factories are located. Among the leading areas of employment are Los Angeles, Chicago, New York, Philadelphia, Boston, San Francisco, and Houston.

Training, Other Qualifications, and Advancement

A 4-year formal apprenticeship is the best way to learn the machinist trade, but some companies have shorter training programs for single-purpose machines. Many machinists do learn this trade on the job, however.

Persons interested in becoming machinists should be mechanically inclined to use the tools and machines required to build complex mechanisms. They also should be temperamentally suited to do highly accurate work that requires concentration as well as physical effort. Prospective machinists should be able to work independently. Although the work sometimes is tedious and repetitious, all-round machinists frequently have the satisfaction of seeing the final results of their work. They also often are able to switch from making one product to another; as a result, variety is a major feature of all-round machinists' work.

A high school or vocational school education, including mathematics, physics, or machine shop training, is desirable. Some companies require experienced machinists to take additional courses in mathematics and electronics at company expense to work with newer metalworking technologies, such as numerically controlled machine tools. In addition, equipment builders generally provide training in the electrical, hydraulic, and mechanical aspects of machine-and-control systems.

Typical machinist apprentice programs consists of approximately 8,000 hours of shop training and about 570 hours of related classroom instruction. In shop training, apprentices learn chipping, filing, hand tapping, dowel fitting, riveting, and the operation of various machine tools. In the classroom, they study blueprint reading, mechanical drawing, shop mathematics, and shop practices.

Many all-round machinists become supervisors. Others take additional training and become tool-and-die or instrument makers. Skilled machinists may open their own shops or advance into other technical jobs in machine programming and tooling.

Job Outlook

The number of all-round machinists is expected to increase about as fast as the average for all occupations through the 1980's. Growth in the demand for machined metal parts will cause most of the increase. In addition, many openings will arise from the need to other fields of work, retire, or die.

As population and incomes rise, so will the demand for machined goods, such as automobiles, household appliances, and industrial products. However, technological developments that increase the productivity of machinists are expected to keep employment from rising as fast as the demand for machined goods.

Chief among these technological innovations is the use of numerically controlled machine tools. These machines, which use computers to control various machining operations, significantly reduce the time for machining operations.

Much of the employment growth will occur in the maintenance shops of manufacturing plants as industries continue to use a greater volume of complex machinery and equipment. More skilled maintenance machinists will be needed to prevent costly breakdowns in highly mechanized plants. Often the breakdown of just one machine can stop an entire production line for hours.

Employment of machinists is relatively insensitive to the business cycle. Instead of being stimulated by demand for consumer goods, employment of production machinists is tied to the development of new industrial machinery. Even when demand for a particular consumer durable good is down--automobiles, for example--machinists are needed to retool in order to make new product lines.

Employment of machinists involved in plant maintenance also is insensitive to economic downturns. Proper maintenance and repair of costly equipment remain vital concerns even when production levels fall.

Related Occupations

Occupations most closely related to all-round machinists are, of course, the other machining occupations. These include tool-and-die makers, machine tool operators, machine tool setup workers, and instrument makers. Other occupations that require precision and skill in working with metal include arc cutters, blacksmiths, gunsmiths, locksmiths, metal patternmakers, and welders.

Sources of Additional Information

For information on career opportunities in the machine tool industry, contact: The National Machine Tool Builders Association, 7901 Westpark Drive, McLean, VA 22102.

Information on apprenticeship training, including recommended apprenticeship standards for tool-and-die makers certified by the U.S. Department of Labor's Bureau of Apprenticeship and Training can be obtained from: The National Tool, Die and Precision Machining Association, 9300 Livingston Road, Washington, D.C. 20022.

For information on apprenticeship training in the Chicago area, contact: The Tool and Die Institute, 777 Busse Highway, Park Ridge, IL 60068.

Many local offices of State employment services provide free aptitude testing to persons interested in becoming all-round machinists or tool-and-die makers. In addition, the State employment service refers applicants for apprentice programs to employers. In many communities, labor-management apprenticeship committees accept applications for apprenticeship.

Apprenticeship information also may be obtained from the following unions (which have local offices in many cities).

ELECTROMECHANICAL TECHNOLOGY PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Electromechanical Technology in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following curriculum exit points.*

Electrician Helper	(D.O.T. Code 829.684-022)
Electrician	(D.O.T. Code 824.681-010)
Refrigeration Mechanic Helper	(D.O.T. Code 637.687-014)
Air Conditioning Installer-Servicer Helper, Window Unit	(D.O.T. Code 637.687-010)
Maintenance Mechanic Helper	(D.O.T. Code 638.684-018)
Maintenance Repairer Helper	(D.O.T. Code 899.684-022)
Electronic Production Line Maintenance Mechanic	(D.O.T. Code 629.281-022)
Gas Appliance Servicer Helper	(D.O.T. Code 637.684-010)
Electrical Appliance Preparer	(D.O.T. Code 827.584-010)
Household Appliance Installer	(D.O.T. Code 827.661-010)
Refrigerator Tester	(D.O.T. Code 827.384-010)
Gas Leak Tester	(D.O.T. Code 827.584-010)
Air Conditioning Installer-Servicer, Window Unit	(D.O.T. Code 637.261-010)
Electrical Appliance Servicer	(D.O.T. Code 827.261-010)
Electrical Apprentice	(D.O.T. Code 824.261-014)

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*Dictionary of Occupational Titles. Washington: U.S. Department of Labor, 1977.

Although designed as a two year curriculum, some students may desire to pursue additional Electromechanical Technology program areas during a third year of study. With appropriate instruction, a third year should enable students to acquire sufficient fundamental competencies from which they may pursue the following curriculum exit points* either at the postsecondary level or in the workforce.

Electrician	(D.O.T. Code 824.261-010)
Electrical Repairer	(D.O.T. Code 829.281-014)
Pneumatic Tool Repairer	(D.O.T. Code 630.281-010)
Electromechanical Technician	(D.O.T. Code 710.281-018)
Fluid Power Mechanic	(D.O.T. Code 600.281-010)

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*Dictionary of Occupational Titles. Washington: U.S. Department of Labor, 1977.

DEFINITION OF D.O.T. CODE*

As a result of technological, economic and sociological influences, nearly every job in the economy is performed slightly differently from any other job. Every job is also similar to a numnumber of other jobs. In order to look at the millions of jobs in an organized way, job titles are designated a 9-digit occupational code. Each set of three digits in the D.O.T. Code has a specific purpose or meaning that differentiates it from all other codes.

In the D.O.T. Code, the first three digits identify a specific occupational group. In the code 652.382-010, the first digit indicates an occupational category. The second digit refers to a division within the occupational category. The third digit defines a specific occupational group within a division.

The middle three digits of the D.O.T. Code 652.382-010 are the worker function rating of the tasks performed in the occupation. Every job requires a worker to function, to some degree, in relation to data, people and things. A separate digit expresses the worker's relationship to each of these three groups. Worker functions involving more complex responsibility and judgment are assigned lower numbers while functions which are less complicated have high numbers.

The last three digits of the D.O.T. Code 652.382-010 indicate the alphabetical order of titles within 6-digit code groups. They serve to differentiate a particular occupation from all others. A number of occupations may have the same first six digits, but no two D.O.T. Code can have the same nine digits.

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*Dictionary of Occupational Titles, 1977 ed.

DESCRIPTION OF OCCUPATIONAL EXIT POINTS*

827.584-010 ELECTRICAL-APPLIANCE PREPARER (any ind.) uncrater.

Assembles and tests electrical appliances, such as ranges, refrigerators, and washing machines, to prepare for delivery and installation, using handtools and test lamp: Uncrates appliances, using pry bar, wire cutters, and nail puller. Assembles appliance parts, using screws and handtools. Connects appliance to electric current to test performance. Locates faulty circuits with test lamp. Solders and wraps wires with friction tape to repair insulation. Washes and polishes appliances. Examines exterior of appliance for chips, scratches, and dents. Keeps records of appliances received, assembled, and delivered. May be designated according to type of appliance assembled and tested as DISHWASHER PREPARER (any ind.); ELECTRIC-RANGE PREPARER (any ind.); ELECTRIC-REFRIGERATOR PREPARER (any ind.); WASHER-DRIER PREPARER (any ind.).

827.661-010 HOUSEHOLD-APPLIANCE INSTALLER (any ind.)

Installs household appliances, such as refrigerators, washing machines, stoves, and related appliances, in mobile homes or customers' homes, using handtools: Levels refrigerators and adjusts doors. Connects water pipes to washing machines, using plumbing tools. Observes complete cycle of automatic washers and dryers and makes adjustments. Lights and adjusts pilot lights on gas stoves and examines valves and burners for gas leakage and specified flame. May assemble and install prefabricated kitchen cabinets in conjunction with appliances. May stain or finish cabinets.

829.684-022 ELECTRICIAN HELPER (any ind.) wirer helper

Assists ELECTRICIAN (any ind.) to install and repair electrical wiring, fixtures, and equipment, performing any combination of following tasks: Measures, cuts, and bends wire and conduit, using ruler and handtools. Drills holes for wiring, using power drill, and pulls or pushes wiring through opening. Assists in lifting, positioning, and fastening objects, such as wiring, conduit, and motors. Performs minor repairs, such as replacing fuses, light sockets, bulbs, and switches, using handtools. Maintains tools and equipment and keeps supplies and parts in order. Disassembles defective electrical equipment, such as motors, using handtools. Performs other duties as described under HELPER (any ind.).

*Dictionary of Occupational Titles. Washington: U.S. Department of Labor, 1977.

637.684-010 GAS-APPLIANCE-SERVICER HELPER (any ind.) customer-servicer helper; gas-fitter helper.

Assists GAS-APPLIANCE SERVICER (any ind.) in installing, testing, adjusting, and repairing regulators, ranges, and heaters, in customer's establishments: Transports tools, parts, equipment, and appliances from truck to customer's establishment, using handtruck. Measures, cuts threads, and connects pipe to feeder line and installed appliance, using pipe cutter, threader, and wrench. Dismantles appliances and replaces defective pipes, thermocouples, thermostats, valves, and spindles, using handtools. Performs other duties as described under HELPER (any ind.). May be designated according to kind of appliance repaired as GAS-STOVE-SERVICER HELPER (any ind.).

637.687-014 REFRIGERATION-MECHANIC HELPER (any ind.)

Assists REFRIGERATION-MECHANIC (any ind.) in installing, maintaining, and repairing industrial and commercial refrigerating systems: Transports tools, materials, components, and refuse to and from work area. Lifts or holds parts while REFRIGERATION MECHANIC (any ind.) fits, alines, and fastens them into position. Bolts or unbolts parts, using handtools. May cut and thread pipe to specified length, using pipe cutter, stock, and die. May insulate cabinets and systems. Performs other duties as described under HELPER (any ind.).

899.684-022 MAINTENANCE-REPAIRER HELPER, FACTORY OR MILL (any ind.) general-maintenance helper.

Assists MAINTENANCE REPAIRER, FACTORY OR MILL (any ind.) in repairing and maintaining machinery, plumbing, physical structure, and electrical wiring and fixtures of commerical and industrial establishments: Bends and cuts conduit, cuts wires, and drills holes in walls, floors, or ceilings for electrical connections. Connects wires to motors, fixtures, and other electrical equipment, replaces switches and fuses, and splices wires and insulates wires with friction tape. Bends, cuts, and threads pipe, cuts openings in walls, ceilings, and floors for pipes, and seals pipe joints with sealing compound or molten lead. Dismantles machines or equipment, replaces defective parts and motors, and adjusts feed mechanisms. Performs routine maintenance on machines, such as cleaning and lubricating shafts, pulleys, gears, and bearings, using rags, brushes, grease gun, and oilcan. Cuts out and joins parts for worktables, benches, shelves and other furnishings, using handtools and materials, such as saws, hammers, nails, and screws. Paints walls, ceilings, or fixtures of building. Patches or replaces plaster, clears clogged drains, and replaces washers. Replaces or repairs machine belts. Removes dust, dirt, grease, and waste material from machines. Paints machines or equipment to prevent corrosion. Performs other duties as described under HELPER (any ind.).

829.281-014 ELECTRICAL REPAIRER (any ind.) electrician, maintenance; electrician, repair; trouble shooter, electrical.

Repairs, maintains, and installs electrical systems and equipment, such as motors, transformers, wiring, switches, and alarm systems: Locates and determines electrical malfunction, using test instruments, such as ammeter, oscilloscope, and test lamp. Repairs malfunction by such methods as replacing burnt-out elements and fuses, by-passing or replacing defective wiring, filing switch contact points, and cleaning or rewiring motors, using handtools. Tests electrical equipment, such as generators and heaters, for safety and efficiency, using standard test equipment. Installs fixtures, motors, and other electrical equipment and makes adjustments, using handtools. Inspects circuits and wiring for specified shielding and grounding and repairs or rewires system according to building codes and safety regulations. May replace bearings in electric motors. May repair mechanical, pneumatic, hydraulic, or electronic components of electrical equipment, using standard tools and gages. May plan layout and wire new installations [ELECTRICIAN (any ind.)]. May be required to hold license. May be designated according to equipment repaired as CIRCUIT-BREAKER MECHANIC (light, heat, & power); ELECTRICIAN, CRANE MAINTENANCE (any ind.); ELECTRICIAN, RECTIFIER MAINTENANCE (light, heat, & power); SALVAGE REPAIRER (light, heat, & power) I; TIME CLOCK REPAIRER (elec. equip.); TRANSFORMER-COIL WINDER (light, heat, & power); or according to work location as ELECTRICIAN, MACHINE SHOP (mach. shop); ELECTRICIAN, REFINERY (petrol. refin.); UNDERGROUND REPAIRER (light, heat, & power). Additional titles: WATCH ELECTRICIAN (tel. & tel.); WIRER, MAINTENANCE (light, heat, & power).

637.261-010 AIR-CONDITIONING INSTALLER-SERVICER, WINDOW UNIT (any ind.)

Installs, services, and repairs air-conditioning units, ranging from 1/2 to 2 tons capacity, in private residences and small business establishments: Examines unit visually for defective parts, or listens to machine in operation, utilizing knowledge of mechanical, electrical, and refrigeration theory, to determine cause of malfunction. Dismantles whole or part of machine, as indicated by type of malfunction, and repairs or replaces such parts as switches, relays, fan motors, thermostats, and other components, using handtools and power tools. Replaces filters, lubricates unit, and adjusts controls. Reassembles machine, making necessary adjustments to insure efficient operation. May estimate cost of repairs or adjustments. May remove machines from customer's premises for major repairs or overhaul in shop, or for return to manufacturer for extensive repairs. May repair sealed refrigeration units of machines.

827.384-010 REFRIGERATOR TESTER (refrigerat. equip.)

Inspects and tests refrigeration units to evaluate functional operation of system, using knowledge of refrigeration systems and operating specifications: Connects unit to electrical outlet and starts compressor. Observes units to detect malfunction and insure that cooling is taking place. Tests compressors on nonfunctioning units for specified wattage, using watt-meter. Times operating cycle of unit, using watch and replaces relay switches, or orders compressor replacement to regulate length of operating cycle. Feels lines and other components at various points in system to determine if unit is functioning. Examines coolant lines for damage and accumulations of frost indicating constriction or obstruction in lines. Records and attaches inspection tag to malfunctioning units, indicating type and location of defects. May attach gages to verify conformance of unit to temperature, pressure, B.T.U., and other operational specifications. May work in controlled temperature room.

827.584-014 GAS-LEAK TESTER (refrigerat. equip.)

Performs one or more of following tasks to test assembled and charged refrigeration units for refrigerant leaks: Adjusts controls to set balance and range of electronic leak tester. Moves nozzle of tester along refrigerant lines, condenser, and compressor and listens for buzzer indicating presence of gas. Narrows range of tester and probes area to pinpoint exact location of leak. Turns valve of gas tester to adjust flow of gas to copper flame-ring and ignites gas. Moves suction hose, joined to flame-ring, along surfaces of refrigeration unit and observes flame for change in color denoting presence of leaking refrigerant gas. Wraps wet litmus paper around joints of refrigeration unit and observes paper for color change indicating refrigerant leak. Marks number of defective part or joint on inspection tag, according to blueprint numbering chart, and attaches tag to unit. Records number and location of leaks on inspection chart.

824.261-010 ELECTRICIAN (any ind.) wirer.

Plans layout, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment: Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes. Prepares sketches showing location of wiring and equipment, or follows diagrams or blueprints, insuring that concealed wiring is installed before completion of future walls, ceilings, and flooring. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using such tools as hacksaw, pipe threader, and conduit bender. Pulls wiring through conduit, assisted by ELECTRICIAN HELPER (any ind.). Splices wires by stripping insulation from terminal leads with knife or pliers, twisting or soldering wires together, and applying tape or terminal caps. Connects wiring to lighting fixtures and power equipment, using handtools. Installs control and distribution apparatus, such as switches, relays, and circuit-breaker panels, fastening in place with screws or bolts, using handtools and power tools. Connects power cables to equipment, such as electric range or motor, and installs grounding leads. Tests continuity of circuit to insure electrical compatibility and safety of components, using testing instruments, such as ohmmeter, battery and buzzer, and oscilloscope. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement. May repair faulty equipment or systems [ELECTRICAL REPAIRER (any ind.)]. May be required to hold license. May cut and weld steel structural members, using flame-cutting and welding equipment. May be designated according to work location as MINE ELECTRICIAN (mining & quarrying).

824.261-014 ELECTRICIAN APPRENTICE (any ind.)

Performs duties as described under APPRENTICE (any ind.).

A worker who learns, according to written or oral contractual agreement, a recognized skilled craft or trade requiring one or more years of on-the-job training through job experience supplemented by related instruction, prior to being considered a qualified skilled worker. High school or vocational school education is often a prerequisite for entry into an apprenticeship program. Provisions of apprenticeship agreement regularly include length of apprenticeship; a progressive scale of wages; work processes to be taught; and amount of instruction in subjects related to the craft or trade, such as characteristics of materials used, physics, mathematics, estimating, and blueprint reading. Apprenticeability of a particular craft or trade is best evidenced by its acceptability for registration as a trade by a State apprenticeship agency or the Federal Bureau of Apprenticeship and Training. Generally, where employees are represented by a union, apprenticeship programs come under the guidance of joint apprenticeship committees composed of representatives of the employers or the employer association and representatives of the employees. These committees may determine need for apprentices in a locality and establish minimum apprenticeship standards of education, experience, and training. In instances where committees do not exist, apprenticeship agreement is made between apprentice and employer, or an employer group. The title, APPRENTICE, is often loosely used as a synonym for beginner, HELPER (any ind.), or TRAINEE (any ind.). This practice is technically incorrect and leads to confusion in determining what is meant. Typical classifications for apprentices are BLACKSMITH APPRENTICE (forging); MACHINIST APPRENTICE (mach. shop); and PLUMBER APPRENTICE (const.).

827.261-010 ELECTRICAL-APPLIANCE SERVICER (any ind.) appliance-service representative.

Installs, services, and repairs stoves, refrigerators, dishwashing machines, and other electrical household or commerical appliances, using handtools, test equipment, and following wiring diagrams and manufacturers's specifications: Connects appliance to power source and test meters, such as wattmeter, ammeter, or voltmeter. Observes readings on meters and graphic recorders. Examines appliance during operating cycle to detect excess vibration, overheating, fluid leaks, and loose parts. Disassembles appliance and examines mechanical and electrical parts. Traces electrical circuits, following diagram, and locates shorts and grounds, using ohmmeter. Calibrates timers, thermostats, and adjusts contact points. Cleans and washes parts, using wire brush, buffer, and solvent, to remove carbon, grease, and dust. Replaces worn or defective parts, such as switches, pumps, bearings, transmissions, belts, gears, blowers, and defective wiring. Repairs and adjusts appliance motors. Reassembles appliance, adjusts pulleys, and lubricates moving parts, using handtools and lubricating equipment. May be known according to appliance repaired as CLOTHES-DRIER REPAIRER (any ind.); COFFEE-MAKER SERVICER (any ind.); DISHWASHING-MACHINE REPAIRER (any ind.); ELECTRIC-RANGE SERVICER (any ind.); ELECTRIC-REFRIGERATOR SERVICER (any ind.); WASHING-MACHINE SERVICER (any ind.).

630.281-010 PNEUMATIC-TOOL REPAIRER (any ind.) air-motor repairer; drill doctor.

Repairs pneumatic tools and air motors, such as pneumatic hammers, chisels, and reamers, using mechanic's tools: Starts motor or tool and listens to sound to locate cause of trouble. Disassembles motor and repairs or replaces defective gears, pistons, connecting rods, and other parts, using taps, files, wrenches, and other handtools.

600.281-010 FLUID-POWER MECHANIC (any ind.)

Fabricates, assembles, services, maintains, repairs, and tests fluid power equipment, such as power steering units, and components, following blueprints, schematics, or drawings, using handtools, power tools, and testing devices and applying knowledge of hydraulic, pneumatic, and electrical principles: Analyzes blueprints, schematics, diagrams, and drawings to determine fabrication specifications. Sets up and operates milling machines, lathes, shapers, grinders, drill presses, and welders to make precision parts. Verifies conformance to specifications, using instruments, such as micrometers, verniers, and calipers. Assembles fluid power components, such as pumps, cylinders, valves, reservoirs, motors, accumulators, filters, and controls, using handtools and holding devices. Connects unit to test equipment, and analyzes and records data, such as fluid pressure, flow measure, and power loss due to friction and parts wear. Recommends modifications in unit and in test procedures, instrumentation, or setup, based on analysis of test results.

824.681-010 ELECTRICIAN (mfd. bldgs.)

Installs and repairs wiring, electrical fixtures, and fuse boxes in prefabricated and modular homes, using handtools: Reads blueprints to determine locations of equipment and conformance to building and safety codes. Measures, cuts, and installs conduit in specified panels, using handtools. Measures for location of receptacles with tape measure and installs receptacles. Cuts and connects wires according to diagrams to install fixtures, such as switches, light fixtures, and fuse boxes. Test continuity of circuits to insure safety, using ohmmeter. Repairs faulty systems. May direct workers in boring holes in studs and running wiring. May train new workers in electrical system installation procedures.

638.684-018 MAINTENANCE-MECHANIC HELPER (any ind.) machine-adjuster helper; repair helper.

Assists MAINTENANCE MECHANIC (any ind.) in repairing and maintaining machinery and mechanical equipment: Carries tools and equipment to and from storage and working areas. Holds scaffolding members in place or tightens bolts to erect working platforms about machines. Pulls handlines to raise materials and tools to working levels. Loosens bolts to dismantle machinery. Drills and breaks up concrete, using jackhammer. Digs trenches for machinery foundations. Mixes and pours concrete for foundations. Cleans machines with sandpaper, solvent, and wiping rags to prepare surfaces for painting. Oils and greases machines. Performs other duties as described under HELPER (any ind.).

637.687-010 AIR-CONDITIONING INSTALLER-SERVICER HELPER, WINDOW UNIT (any ind.)

Assists AIR-CONDITIONING INSTALLER-SERVICER, WINDOW UNIT (any ind.) in repairing, servicing, or installing window-mounted air-conditioning units, performing any combination of following duties: Carries unit from delivery vehicle to worksite. Assembles window-support brackets, using handtools. Cuts opening through wall for insertion of unit, using hammer and chisel. Applies calking compound to excess space between air conditioner and wall opening. Performs other duties as described under HELPER (any ind.).

710.281-018 ELECTROMECHANICAL TECHNICIAN (inst. & app.)

Fabricates, tests, analyzes, and adjusts precision electromechanical instruments, such as temperature probes, gyroscope units, telemetering systems, altimeters, and aerodynamic probes, following blueprints and sketches, using handtools, metalworking machines, and measuring and testing instruments: Operates metalworking machines, such as bench lathe, milling machine, punch press, and drill press, to fabricate housings, fittings, jigs and fixtures, and verifies dimensions, using micrometer and calipers. Assembles wires, insulation, and electrical components, such as resistors and capacitors, following method layouts, using fixtures, binocular microscope, soldering tools, tweezers, and handtools. Installs electrical assemblies and hardware in housing, using handtools and soldering equipment. Tests assembled instruments for circuit continuity and operational reliability, using multimeter, oscilloscope, oscillator, vacuum tube voltmeter, and bridge. Analyzes test results and repairs or adjusts instruments according to analysis. Records test results and writes report on fabrication techniques used. May calibrate instrument dials according to established standards. May specialize in assembly of prototype instruments and be designated as DEVELOPMENT TECHNICIAN (inst. & app.), or in assembly of production instruments and be designated as FABRICATION TECHNICIAN (inst. & app.).

629.281-022 ELECTRONIC-PRODUCTION-LINE-MAINTENANCE MECHANIC (electronics)

Repairs and maintains machines and equipment used in processing and assembly of electronic components, such as capacitors, resistors, semiconductor devices and assemblies for television, radio communication, and radar systems, following blueprints and other specifications using handtools and test equipment: Starts equipment or machine, such as diffusion furnace, wave solderer, or ultrasonic welder, and inspects mechanical or electrical units and controls to determine malfunctions. Reads blueprints and schematic drawings to determine repair procedures. Dismantles machine and disconnects controls, using screwdrivers, wrenches, wire cutters, and other handtools. Removes and sets aside defective units for repair or replacement. Assembles and installs equipment, such as shafting, conveyor, wiring, tubing, and controls, using hand and power tools. Adjusts sensitive electrical, thermal and timing elements to meet specifications. Starts repaired or newly installed machines and verifies readiness for operation. Records type of malfunction and repair work performed. May prepare requisitions for material and supplies. May repair electronic control units. May be designated ELECTRONICS TECHNICIAN, AUTOMATED PROCESS (electronics).

THE VDARE PROCESS

A resource for assessing an individual's capabilities an initiating job placement action is the VOCATIONAL DIAGNOSIS and ASSESSMENT of RESIDUAL EMPLOYABILITY (VDARE) process. Its purpose is described in Vocational Assessment Planning and Jobs.

> "...is designed for job analysis and the assessment of vocational potential. Utilizing the Dictionary of Occupational Titles (DOT), the client's personal history, and current level of functioning, information (medical, psychological, social, educational and vocational) is synthesized to predict vocational functional potential. The Process Worksheet is used to record, synthesize and analyze the vocationally relevant information about the client's potential to work."[1]

The objective of this process is aiding the vocational professional; i.e., instructor, counselor, or administrator in placing a student's assessed qualifications before prospective employers. The assessment of personal qualifications is unique to each individual and is accomplished through trait factor analysis.

The VDARE process isolates the individual traits and matches them to occupations which use or accommodate the particular grouping of traits which result from the trait factor analysis. The matching is accomplished via a computer search of VDARE's data bank which contains the classification of jobs according to worker trait factors. Each of 12,099 jobs are factored in eleven categories:

"1) DOT Code
2) Data/People/Things (DPT) Number
3) Guide to Occupational Exploration (GOE) Code
4) Job title
5) Physical Demands
6) Working Conditions
7) General Educational Development (Reasoning, Math, Language)
8) Specific Vocational Preparation
9) Aptitudes
10) Interests
11) Temperaments"[2]

If you are interested in pursuing a trait factor analysis, each case study begins with the "VDARE Process Worksheet". This form presents the client's biographical data, educational/training and work history. A medical report, vocational/psychological testing, work evaluation and behavioral observations add further definitions of the individual's traits. The resulting measures of these traits are recorded onto the "Vocational Relevant Information" section of the VDARE worksheet. This data is matched through a computer search to occupations in which the client may be expected to function successfully.

The worker trait factors for your particular program are presented on the following pages. Although these are composite descriptions of occupations as they may typically occur, they may not always coincide with a specific job as it is actually performed in a particular work environment.

For further information, contact:

VDARE Service Bureau
Dr. Tim Field
P.O. Box 1945
Athens, GA 30603
(404) 548-8161

1) Sink, J.M. and Field, T.F. Vocational Assessment Planning and Jobs. Athens, GA: VDARE Service Bureau, 1981.

2) Field, T.F. and Field, J.E. The Classification of Jobs According to Worker Trait Factors. Roswell, GA: North Fulton Printing, 1982.

ELECTRICIAN HELPER
829.684-022*

DATA, PEOPLE, THINGS

Persons desiring to become electrician helpers should have the ability to make comparisons. They should be able to take instructions and help others. They must use body members, tools and devices to work, move, or place objects or materials. They must have the ability to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Electrician helpers have a medium work load. They must be able to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger and feel.

WORKING CONDITIONS

Electrician helpers spend the majority of their working time inside in environments which may be hazardous.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electrician helpers must apply common sense understanding to carry out written or oral instructions. Occasionally they must deal with problems involving concrete variables.

Mathematics: Electrician helpers must use arithmetic to add, subtract, multiply and divide whole numbers.

Language: Electrician helpers must be able to learn job duties from oral instuctions or demonstrations. They must be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over thirty days up to and including three months.

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	low	Manual Dexterity:	medium
Numerical:	low	Eye-Hand-Foot Coordination:	low
Spatial:	medium	Color Discrimination:	high
Form Perception:	medium		
Clerical Perception:	high		
Motor Coordination:	medium		

INTERESTS

Electrician helpers have a preference for activities dealing with things and objects. They prefer activities that are routine, concrete and organized in nature. They also prefer activities related to processes, machines and techniques.

TEMPERAMENTS

Electrician helpers should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTRICIAN
824.681-010*

DATA, PEOPLE, THINGS

Persons desiring to become electricians should have the ability to make comparisons. They should be able to take instructions and help others when necessary. Additionally, they must use body members and tools to work, move, guide or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electricians have a light work load. They must be able to stoop, kneel, crouch and crawl. They should have the ability to reach, handle, finger, and feel. Additionally, they should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Electricians spend the majority of their working time inside. The working environment may sometimes be noisy.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electricians must apply common sense understanding to carry out written or oral instructions. They must deal with problems involving concrete variables.

Mathematics: Electricians must make mathematical calculations involving fractions, decimals and percentages.

Language: Electricians must be able to learn job duties from oral instructions or demonstrations. They must be able to transcribe information and fill in report forms. Self-employed electricians should have some ability to file, post, and mail such material as forms, checks, receipts and bills.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over three months up to and including six months.

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	medium
Numerical:	low	Eye-Hand-Foot Coordination:	negligible
Spatial:	medium	Color Discrimination:	high
Form Perception:	medium		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Electricians have a preference for activities dealing with things and objects. Additionally, they have a preference for activities that are carried on in relation to processes, machines and techniques.

TEMPERAMENTS

Electricians should have the capability to make generalizations, evaluations or decisions based on measurable or verfiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

REFRIGERATION-MECHANIC HELPER
637.687-014*

DATA, PEOPLE, THINGS

Persons desiring to become refrigeration-mechanic helpers should have the ability to make comparisons. They should be able to take instructions and help others. They must use body members, tools and special devices to work, move or carry objects or materials. They have little latitude for judging the attainment of standards or in selecting appropriate tools, objects or materials.

PHYSICAL DEMANDS

Refrigeration-mechanic helpers have a heavy work load. They must be able to stoop, kneel, crouch, crawl, reach, handle, finger, and feel. They should be able to exchange ideas by means of the spoken word and perceive the nature of sounds by the ear.

WORKING CONDITIONS

Refrigeration-mechanic helpers spend a majority of their working time inside. They work in environments where they are exposed to cold, temperature changes, noise, vibration, hazardous conditions, fumes, odors, toxic conditions, dust and poor ventilation.

GENERAL EDICATION DEVELOPMENT

Reasoning: Refrigeration-mechanic helpers must apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Occasionally they must deal with problems involving a few concrete variables.

Mathematics: Refrigeration-mechanic helpers must perform simple addition and subtraction, read and copy figures, or count and record.

Language: Refrigeration-mechanic helpers must be able to transcribe information and fill in report forms. They must learn job duties from oral instructions or demonstrations.

SPECIFIC VOCATIONAL PREPARATION

Training time should be anything beyond short demonstration up to and including thirty days.

APTITUDES

Intelligence:	low	Finger Dexterity:	low
Verbal:	low	Manual Dexterity:	low
Numerical:	low	Eye-Hand-Foot Coordination:	negligible
Spatial:	low		
Form Perception:	low	Color Discrimination:	negligible
Clerical Perception:	low		
Motor Coordination:	low		

INTERESTS

Refrigeration-mechanic helpers have a preference for activities dealing with things and objects. They prefer activities that are routine, concrete and organised in nature.

TEMPERAMENTS

Refrigeration-mechanic helpers must be able to perform repetitive work, or to perform continuously the same work, according to set procedures, sequence or pace.

*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

AIR CONDITIONING INSTALLER-SERVICER HELPER, WINDOW UNIT
637.687-010*

DATA, PEOPLE, THINGS

Persons desiring to become air conditioning installer-servicer helpers should have the ability to make comparisons. They should be able to take instructions and help others. Additionally, they must use body members, tools or special devices to work, move or carry objects or materials. They must have the ability to select appropriate tools, objects or materials to perform their job.

PHYSICAL DEMANDS

Air conditioning installer-servicer helpers have a heavy work load. They must be able to climb, balance, stoop, kneel, crouch and crawl. They must also be able to reach, handle, finger and feel.

WORKING CONDITIONS

Air conditioning installer-servicer helpers spend equal amounts of their working time inside and outside in environments which may be hazardous.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Air conditioning installer-servicer helpers must apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Occasionally they must deal with problems involving concrete variables.

Mathematics: Air conditioning installer-servicer helpers must perform simple addition and subtraction, read and copy figures, or count and record.

Language: Air conditioning installer-servicer helpers must be able to learn job duties from oral instructions or demonstrations. They must be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over 30 days up to and including three months.

APTITUDES

Intelligence:	low	Finger Dexterity:	low
Verbal:	low	Manual Dexterity:	low
Numerical:	low	Eye-Hand-Foot Coordination:	negligible
Spatial:	low		
Form Perception:	low	Color Discrimination:	low
Clerical Perception:	low		
Motor Coordination:	low		

INTERESTS

Air conditioning installer-servicer helpers have a preference for activities dealing with things and objects. They also prefer activities that are routine, concrete and organized in nature.

TEMPERAMENTS

Air conditioning installer-servicer helpers should have the capability to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

MAINTENANCE-MECHANIC HELPER
638.684-018*

DATA, PEOPLE, THINGS

Persons desiring to become maintenance-mechanic helpers should have the ability to make comparisons. They should be able to take instructions and help others. They must use body members, tools or special devices to work, move, guide or place objects or materials. They must have the ability to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Maintenance-mechanic helpers have a heavy work load. They should have the ability to reach, handle, finger, and feel. Additionally, they should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Maintenance-mechanic helpers spend the majority of their working time inside. The working environment may sometimes be noisy and hazardous.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Maintenance-mechanic helpers must apply common sense understanding to carry out written or oral instructions. They sometimes must deal with problems involving concrete variables.

Mathematics: Maintenance-mechanic helpers must perform simple addition and subtraction, read and copy figures, or count and record.

Language: Maintenance-mechanic helpers must be able to learn job duties from oral instructions or demonstrations. Additionally, they must be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over three months up to and including six months.

APTITUDES

Intelligence:	low	Finger Dexterity:	medium
Verbal:	low	Manual Dexterity:	medium
Numerical:	low	Eye-Hand-Foot Coordination:	low
Spatial:	low	Color Discrimination:	low
Form Perception:	low		
Clerical Perception:	medium		
Motor Coordination:	medium		

INTERESTS

Maintenance-mechanic helpers have a preference for activities dealing with things and objects. They prefer activities that are routine, concrete and organized in nature. Additionally, they have a preference for activities that are carried on in relation to processes, machines and techniques.

TEMPERAMENTS

Maintenance-mechanic helpers should have the capability to perform repetitive work, or to perform continuously the same work, according to set procedures, sequence or pace.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

MAINTENANCE-REPAIRER HELPER
899.684-022*

DATA, PEOPLE, THINGS

Persons desiring to become maintenance-repairer helpers should have the ability to make comparisons. They should be able to take instructions and help others. They must use body members, tools or special devices to work, move, guide or place objects or materials. They must have the ability to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Maintenance-repairer helpers have a heavy work load. They must be able to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger and feel. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Maintenance-repairer helpers spend the majority of their working time inside in environments which may sometimes be noisy and hazardous.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Maintenance-repairer helpers should be able to apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Occasionally they must deal with problems involving a few concrete variables.

Mathematics: Maintenance-repairer helpers must perform simple addition and subtraction, read and copy figures, or count and record.

Language: Maintenance-repairer helpers should be able to learn job duties from oral instructions or demonstrations. They should be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over six months up to and including one year.

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	low	Manual Dexterity:	high
Numerical:	low	Eye-Hand-Foot Coordination:	low
Spatial:	medium	Color Discrimination:	low
Form Perception:	medium		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Maintenance-repairer helpers have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques.

TEMPERAMENTS

Maintenance-repairer helpers should have the ability to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure. They should require the precise attainment of set limits, tolerances and standards.

*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTRONIC-PRODUCTION-LINE-MAINTENANCE MECHANIC
629.281-022*

DATA, PEOPLE, THINGS

Persons desiring to become electronic-production-line-maintenance mechanics should have the ability to examine and evaluate data. They must be able to take instructions and help others when necessary. They must use body members, tools and devices to work, move or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electronic-production-line-maintenance mechanics have a medium work load. They must be able to stoop, kneel, crouch, crawl, reach, handle, finger and feel. They must be able to express or exchange ideas by means of the spoken word and perceive the nature of sounds by the ear. Additionally, they should have visual acuity, depth perception, field of vision, and color vision.

WORKING CONDITIONS

Electronic-production-line-maintenance mechanics spend the majority or their working time inside in environments which may sometimes be hazardous.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electronic-production-line-maintenance mechanics must have the ability to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic, or schedule form.

Mathematics: Electronic-production-line-maintenance mechanics must perform ordinary arithmetic, algebraic and geometric procedures in standard, practical applications.

Language: Electronic-production-line-maintenance mechanics must have the ability to communicate orally and aurally. They must be able to transcribe information and fill in report forms. Additionally, they should have some ability to file, post, and mail such material as forms, checks, receipts and bills.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over six months up to and including one year.

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	medium
Numerical:	medium	Eye-Hand-Foot Coordination:	negligible
Spatial:	medium		
Form Perception:	medium	Color Discrimination:	medium
Clerical Perception:	medium		
Motor Coordination:	medium		

INTERESTS

Electronic-production-line-maintenance mechanics have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Electronic-production-line-maintenance mechanics should be able to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should have the ability to influence people in their opinions and their judgments about ideas or things.

*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

GAS-APPLIANCE-SERVICER HELPER
637.684-010*

DATA, PEOPLE, THINGS

People desiring to become gas-appliance-servicer helpers should have the ability to make comparisons. They should be able to take instructions and help others. They must use body members, tools or special devices to work, move or place objects or materials. They must have the ability to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Gas-appliance-servicer helpers have a heavy work load. They must be able to climb, balance, reach, handle, finger, and feel. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Gas-appliance-servicer helpers spend an equal amount of their working time inside and outside. Their working environments may be subjected to fumes, odors, toxic conditions, dust and poor ventilation.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Gas-appliance-servicer helpers must apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Occasionally, they must deal with problems involving concrete variables.

Mathematics: Gas-appliance-servicer helpers must use arithmetic to add, subtract, multiply and divide whole numbers.

Language: Gas-appliance-servicer helpers must be able to learn job duties from oral instructions or demonstrations. They must be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over three months up to and including six months.

APTITIUDES

Intelligence: medium
Verbal: low
Numerical: low
Spatial: medium
Form Perception: medium
Clerical Perception: low
Motor Coordination: medium
Finger Dexterity: low
Manual Dexterity: medium
Eye-Hand-Foot Coordination: negligible
Color Discrimination: low

INTERESTS

Gas-appliance servicer helpers have a preference for activies dealing with things and objects. They prefer activities that are routine, concrete and organized in nature.

TEMPERAMENTS

Gas-appliance-servicer helpers should have the ability to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTRICAL-APPLIANCE PREPARER
827.584-010*

DATA, PEOPLE, THINGS

Persons desiring to become electrical-appliance preparers should have the ability to transcribe, enter or post data. They should be able to take instructions and help others when necessary. They must use body members, tools or special devices to work, move, or place objects or materials. They must be able to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Electrical-appliance preparers have a heavy work load. They must be able to stoop, kneel, crouch, crawl, reach, handle, finger and feel.

WORKING CONDITIONS

Electrical-appliance preparers spend a majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electrical-appliance preparers must apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Occasionally, they must deal with problems involving a few concrete variables.

Mathematics: Electrical-appliance preparers must use arithmetic to add, subtract, multiply and divide whole numbers.

Language: Electrical-appliance preparers must be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over thirty days up to and including three months.

APTITUDES

Intelligence:	medium	Finger Dexterity:	low
Verbal:	low	Manual Dexterity:	medium
Numerical:	low	Eye-Hand-Foot Coordination:	negligible
Spatial:	low		
Form Perception:	low	Color Discrimination:	low
Clerical Perception:	low		
Motor Coordination:	low		

INTERESTS

Electrical-appliance preparers have a preference for activities dealing with things and objects. They prefer activities that are routine, concrete and organized in nature. They also prefer activities related to processes, machines and techniques.

TEMPERAMENTS

Electrical-appliance preparers should have the ability to perform repetitive work, or to perform continuously the same work, according to set procedures, sequence or pace. They require the precise attainment of set limits, tolerances or standards.

*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

HOUSEHOLD-APPLIANCE INSTALLER
827.661-010*

DATA, PEOPLE, THINGS

Persons desiring to become household-appliance installers should have the ability to talk with and signal people to convey or exchange information. They should have the ability to make comparisons. They must use body members, tools and devices to work, move or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Household-appliance installers have a heavy work load. They should have the ability to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger and feel.

WORKING CONDITIONS

Household-appliance installers spend the majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Household-appliance installers must apply common sense understanding to carry out detailed but involved written or oral instructions. Occasionally, they must deal with problems involving a few concrete variables.

Mathematics: Household-appliance installers must make mathematical calculations involving fractions, decimals and percentages.

Language: Household-appliance installers must be able to transcribe information and fill in report forms. They must be able to interview members of a household to obtain information related to installation.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over one year up to and including two years.

APTITUDES

Intelligence:	medium	Finger Dexterity:	low
Verbal:	low	Manual Dexterity:	medium
Numerical:	low	Eye-Hand-Foot Coordination:	low
Spatial:	medium	Color Discrimination:	low
Form Perception:	medium		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Household-appliance installers have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Household-appliance installers should be able to perform repetitive work, or to perform continuously the same work, according to set procedures, sequence or pace. They require the precise attainment of set limits, tolerances, or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

REFRIGERATOR TESTER
827.384-010*

DATA, PEOPLE, THINGS

Persons desiring to become refrigerator testers should have the ability to compile information and report or carry out a prescribed action relating to the information gathered. They should be able to take instructions and help others when necessary. They must use body members, tools or special devices to work, move or place objects or materials. They must be able to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Refrigerator testers have a light work load. They should be able to reach, finger and feel. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Refrigerator testers spend the majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Refrigerator testers must apply common sense understanding to carry out detailed but uninvolved written or oral instructions.

Mathematics: Refrigerator testers must use arithmetic to add, subtract, multiply and divide whole numbers.

Language: Refrigerator testers must be able to transcribe information and fill in forms. They should be able to communicate orally and aurally.

SPECIFIC VOCATIONAL PREPARATION

Training time should be six months up to and including one year.

APTITUDES

Intelligence:	medium	Finger Dexterity:	low
Verbal:	medium	Manual Dexterity:	medium
Numerical:	low	Eye-Hand-Foot Coordination:	low
Spatial:	low	Color Discrimination:	medium
Form Perception:	low		
Clerical Perception:	low		
Motor Coordination:	low		

INTERESTS

Refrigerator testers have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Referigerator testers should be able to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

GAS-LEAK TESTER
827.584-014*

DATA, PEOPLE, THINGS

Persons desiring to become gas-leak testers should have the ability to transcribe, enter or post data. They should be able to take instructions and help others when necessary. They must use body members, tools or special devices to work, move, or place objects or materials. They must be able to select appropriate tools, objects or materials to perform a job.

PHYSICAL DEMANDS

Gas-leak testers have a light work load. They must be able to reach, handle, finger and feel. They should have the ability to express or exchange ideas by means of the spoken word. They should be able to perceive the nature of sounds by the ear. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Gas-leak testers spend the majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Gas-leak testers must apply common sense understanding to carry out detailed but uninvolved written or oral instructions. Occasionally they must deal with problems involving a few concrete variables.

Mathematics: Gas-leak testers must perform simple addition and subtraction, read and copy figures, or count and record.

Language: Gas-leak testers should be able to learn job duties from oral instructions or demonstrations. They must be able to communicate orally and aurally.

SPECIFIC VOCATIONAL PREPARATION

Training time should be anything beyond short demonstration up to and including thirty days.

APTITUDES

Intelligence:	low	Finger Dexterity:	low
Verbal:	low	Manual Dexterity:	low
Numerical:	low	Eye-Hand-Foot Coordination:	negligible
Spatial:	low		
Form Perception:	low	Color Discrimination:	low
Clerical Perception:	low		
Motor Coordination:	low		

INTERESTS

Gas-leak testers have a preference for activities dealing with things and objects. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Gas-leak testers should have the ability to perform repetitive work, or to perform continuously the same work, according to set procedures, sequence or pace. They should be able to make generalizations, evaluations or decisions based on measurable or verifiable criteria.

*Field, Tim. *The Classification of Jobs According to Worker Trait Factors*, 1982.

AIR-CONDITIONING INSTALLER-SERVICER, WINDOW UNIT
637.261-010*

DATA, PEOPLE, THINGS

Persons desiring to become air-conditioning installer-servicers should have the ability to examine and evaluate data. They should be able to talk with people to convey or exchange information. This includes giving assignments and directions to helpers and assistants. They must use body members, tools and devices to work, move or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Air-conditioning installer-servicers have a heavy work load. They must be able to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger and feel. They must have the ability to express or exchange ideas by means of the spoken word. They must have the ability to perceive the nature of sounds by the ear. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Air-conditioning installer-servicers spend the majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Air-conditioning installer-servicers must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Air-conditioning installer-servicers must make mathematical calculations involving fractions, decimals and percentages.

Language: Air-conditioning installer-servicers must be able to communicate orally and aurally. They must have the ability to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over four years up to and including ten years.**

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	medium
Numerical:	medium	Eye-Hand-Foot Coordination:	low
Spatial:	high	Color Discrimination:	medium
Form Perception:	medium		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Air-conditioning installer-servicers have a preference for activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Air-conditioning installer-servicers should have the ability to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

**Although this is a composite description of the occupation as it may typically occur, it may not always coincide with a specific job as it is actually performed.

ELECTRICAL-APPLIANCE SERVICER
827.261-010*

DATA, PEOPLE, THINGS

Persons desiring to become electrical-appliance servicers should have the ability to examine and evaluate data. They should be able to talk with people to convey or exchange information. This includes giving assignments and directions to helpers and assistants. They must use body members, tools and devices to work, move or place objects or materials. They must exercise judgment in selecting tools, objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electrical-appliance servicers have a medium work load. They must be able to stoop, kneel, crouch, crawl, reach, handle, finger and feel. They should have visual acuity, depth perception, field of vision, and color vision.

WORKING CONDITIONS

Electrical-appliance servicers spend a majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electricial-appliance servicers must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Electrical-appliance servicers must make mathematical calculations involving fractions, decimals and percentages.

Language: Electrical-appliance servicers must be able to transcribe information and fill in report forms. They must be able to interview people to obtain necessary information about a job to be performed.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	high
Numerical:	medium	Eye-Hand-Foot Coordination:	negligible
Spatial:	medium		
Form Perception:	medium	Color Discrimination:	low
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Electrical-appliance servicers have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Electrical-appliance servicers should be able to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure. They must make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTRICIAN APPRENTICE
824.261-014*

DATA, PEOPLE, THINGS

Persons desiring to become electrician apprentices should have the ability to examine and evaluate data. They should be able to talk with people to convey or exchange information. They must use body members, tools and devices to work, move or place objects or materials. They must exercise judgment in selecting tools, objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electrician apprentices have a medium work load. They must be able to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger, and feel. They should have visual acuity, depth perception, field of vision, and color vision.

WORKING CONDITIONS

Electrician apprentices spend an equal amount of time working inside and outside. They often work in situations in which they are exposed to risks of bodily injury.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electrician apprentices must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Electrician apprentices must perform ordinary arithmetic algebraic and geometric procedures in standard, practical applications.

Language: Electrician apprentices must be able to transcribe information and fill in report forms. They must be able to interview people to obtain necessary information about an electrical job to be performed.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	high	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	medium
Numerical:	high	Eye-Hand-Foot Coordination:	low
Spatial:	high	Color Discrimination:	high
Form Perception:	high		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Electrician apprentices have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Electrician apprentices should be able to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure. They must make generalizations, evaluations or decisions based on sensory, judgmental, measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTRICIAN
824.261-010*

DATA, PEOPLE, THINGS

Persons desiring to become electricians should have the ability to examine and evaluate data. They should be able to talk with people to convey or exchange information. This includes giving assignments and directions to helpers and assistants. They must use body members, tools and devices to work, move or place objects or materials. They must exercise judgment in selecting tools, objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electricians have a medium work load. They must be able to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger, and feel. They should have visual acuity, depth perception, field of vision, and color vision.

WORKING CONDITIONS

Electricians spend an equal amount of time working inside and outside. They often work in situations in which they are exposed to risks of bodily injury.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electricians must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Electricians must perform ordinary arithmetic, algebraic and geometric procedures in standard, practical applications.

Language: Electricians must be able to transcribe information and fill in report forms. They must be able to interview people to obtain necessary information about an electrical job to be performed. Self-employed electricians should have some ability to file, post and mail such material as forms, checks, receipts and bills.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	high	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	medium
Numerical:	high	Eye-Hand-Foot Coordination:	low
Spatial:	high	Color Discrimination:	high
Form Perception:	high		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Electricians have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Electricians should be able to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure. They must make generalizations, evaluations or decisions based on sensory, judgmental, measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTRICAL REPAIRER
829.281-014*

DATA, PEOPLE, THINGS

Persons desiring to become electrical repairers should have the ability to examine and evaluate data. They should be able to take instructions and help others when necessary. They must use body members and tools to work, move, guide or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electrical repairers have a medium work load. They must be able to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger and feel. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Electrical repairers spend the majority of their working time inside in environments which are hazardous.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electrical repairers must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Electrical repairers must perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.

Language: Electrical repairers should be able to communicate orally and aurally. They should be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	high	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	high
Numerical:	high	Eye-Hand-Foot Coordination:	low
Spatial:	high	Color Discrimination:	low
Form Perception:	high		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Electrical repairers have a preference for activites dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Electrical repairers should have the capability to make generalizations, evaluations or decisions based on sensory, judgmental, measurable or verifiable criteria. They should require precise attainment of set limits, tolerances or standards. They should be able to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure.

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*Field, Tim. *The Classification of Jobs According to Worker Trait Factors*, 1982.

PNEUMATIC-TOOL REPAIRER
630.281-010*

DATA, PEOPLE, THINGS

Persons desiring to become pneumatic-tool repairers should have the ability to examine and evaluate data. They should be able to take instructions and help others when necessary. They must use body members and tools to work, move, guide or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Pneumatic-tool repairers have a medium work load. They should be able to reach, handle, finger and feel. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Pneumatic-tool repairers spend the majority of their working time inside often in environments which are noisy and are subjected to fumes, odors, toxic conditions, dust and poor ventilation.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Pneumatic-tool repairers must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Pneumatic-tool repairers must make mathematical calculations involving fractions, decimals and percentages.

Language: Pneumatic-tool repairers must be able to communicate orally and aurally. They must be able to transcribe data from one record to another and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	medium	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	high
Numerical:	medium	Eye-Hand Foot Coordination:	low
Spatial:	medium	Color Discrimination:	negligible
Form Perception:	medium		
Clerical Perception:	low		
Motor Coordination:	medium		

INTERESTS

Pneumatic-tool repairers have a preference for activities dealing with things and objects. They prefer activities related to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Pneumatic-tool repairers should be able to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

ELECTROMECHANICAL TECHNICIAN

710.281-018*

DATA, PEOPLE, THINGS

Persons desiring to become electromechanical technicians should have the ability to examine and evaluate data. They should be able to take instructions and help others when necessary. They must use body members and tools to work, move, guide or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Electromechanical technicians have a light work load. They must be able to reach, handle, finger and feel. Additionally, they should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Electromechanical technicians spend the majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Electromechanical technicians must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Electromechanical technicians must perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.

Language: Electromechanical technicians must be able to communicate orally and aurally. They must interpret technical manuals as well as drawings and specifications, such as layouts, blueprints and schematics.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	high	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	high
Numerical:	high	Eye-Hand-Foot Coordination:	negligible
Spatial:	high	Color Discrimination:	medium
Form Perception:	medium		
Clerical Perception:	high		
Motor Coordination:	medium		

INTERESTS

Electromechanical technicians have a preference for activities dealing with things and objects. The prefer activities that are scientific and technical. They prefer activities that are carried on in relation to processes, machines and techniques. They prefer activities which result in tangible, productive satisfaction.

TEMPERAMENTS

Electromechanical technicians should have the capability to perform a variety of duties, often changing from one task to another of a different nature without loss of efficiency or composure. They should be able to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They require the precise attainment of set limits, tolerances or standards.

*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

FLUID-POWER MECHANIC
600.281-010*

DATA, PEOPLE, THINGS

Persons desiring to become fluid-power mechanics should have the ability to examine and evaluate data. They should be able to take instructions and help others when necessary. They must use body members and tools to work, move, guide or place objects or materials. They must be precise in the jobs they perform.

PHYSICAL DEMANDS

Fluid-power mechanics have a light work load. They must be able to reach, handle, finger and feel. They should have visual acuity, depth perception, field of vision and color vision.

WORKING CONDITIONS

Fluid-power mechanics spend the majority of their working time inside.

GENERAL EDUCATION DEVELOPMENT

Reasoning: Fluid-power mechanics must solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. They must interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

Mathematics: Fluid-power mechanics must perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.

Language: Fluid-power mechanics must be able to communicate orally and aurally. They must be able to transcribe information and fill in report forms.

SPECIFIC VOCATIONAL PREPARATION

Training time should be over two years up to and including four years.

APTITUDES

Intelligence:	high	Finger Dexterity:	medium
Verbal:	medium	Manual Dexterity:	medium
Numerical:	high	Eye-Hand-Foot Coordination:	medium
Spatial:	high	Color Discrimination:	medium
Form Perception:	high		
Clerical Perception:	medium		
Motor Coordination:	medium		

INTERESTS

Fluid-power mechanics have a preference for activities dealing with things and objects. They prefer activities that are scientific and technical in nature. They prefer activities that are related to processes, machines and techniques.

TEMPERAMENTS

Fluid-power mechanics should be able to make generalizations, evaluations or decisions based on measurable or verifiable criteria. They should require the precise attainment of set limits, tolerances or standards.

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*Field, Tim. The Classification of Jobs According to Worker Trait Factors, 1982.

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EMPLOYABILITY SKILLS

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EMPLOYABILITY SKILLS INTRODUCTION

This section provides an overview of employability skills that are desirable in any occupation and relates their significance to the specific occupational area of Electromechanical Technology.

EMPLOYABILITY SKILLS

INTRODUCTION

Possessing employability skills directly influences a person's ability to get and keep a job. The vocational program environment creates an ideal situation for introducing and reinforcing those employability skills necessary for acquiring and keeping a job.

In this section, a discussion of key employability skills are provided and suggestions for incorporating them into your daily program instruction are also included. A thorough discussion of all aspects of employability in such limited space would hardly be feasible. However, the information included does provide a sound base from which you may draw many beneficial ideas.

TOPICS COVERED IN THIS SECTION

1. How is a job search conducted?
2. What steps are involved in preparing for a job interview?
3. What actually happens on a job interview?
4. After securing employment, how are jobs kept?
5. How can employability skills be implemented into your program?

HOW IS A JOB SEARCH CONDUCTED?

Before conducting a job search, students should be asked to assess their abilities and interests. Suggest to them that through several informational resources they can determine personal interests and abilities that can be matched to prospective jobs. The following resources may prove beneficial in assisting students with their personal evaluations.

----self-inventory
----friends
----relatives
----instructors
----grades
----school records
----tests

Once job aptitudes have been established, suggest to students that they research all aspects of a job. Through the following resources, students may obtain information concerning job characteristics.

----personal contacts
----observation and interview
----reading about the job
----writing for information
----reviewing personal past work experiences

When all the necessary job information has been secured, students can begin the job hunt. Below are examples of places to begin the job hunt.

----friends and relatives
----classified ads of the newspaper

----bulletin boards
----yellow pages of the phone book
----company personnel offices
----state personnel offices
----private employment agencies
----union offices
----government work pro-programs

WHAT STEPS ARE INVOLVED IN PREPARING FOR A JOB INTERVIEW?

After locating potential jobs which reflect personal interests and abilities, students should begin preparing for job interviews.

STEP 1: Obtaining Necessary Documents

Before applying for a job, encourage students to secure certain documents such as a birth certificate, social security card and work permit. Having access to these documents makes getting a job much easier. You may suggest to students that transferral of "hard-to-remember" information from those documents to a personal data card may prove more convenient and more accessible.

STEP 2: Applying For The Job

Familiarize students with what a job application is and how it should be filled out. Stress to students that the job application is an employer's initial contact with prospective employees and that the manner in which it is completed directly reflects on the applicant. Encourage students to be comprehensive, accurate and neat when filling out job applications.

In addition to a job application, some employers request that a resume ---- a brief summary of personal characteristics, education and work experiences --- be submitted. Often a letter of application is attached to a resume. The letter briefly introduces the applicant to an employer, specifies the desired job and states qualifications for the job. Advise students to practice developing resumes and letters of application.

STEP 3: Is The Job Really For You?

Students should be encouraged to research the company as well as the prospective job and also to evaluate their feelings toward the job.

STEP 4: Questions and Answers

Assist students in the preparation of questions that an interviewer might ask during an interview. Using those questions, have students simulate a job interview situation. This provides students with practice and helps them to feel more confident in an actual job interview.

STEP 5: Lookin' Good

Discuss with students the importance of looking their best and practicing good hygiene before going to an interview. Encourage students to maintain their health and appearance on a daily basis as well as on job interview days.

STEP 6: On The Way To The Interview

On the day of the interview, students should decide what items and types of information to take with them. You may want to suggest that the following items might be helpful to them.

----personal data card
----pen
----unanswered questions
----interview place
----name of the interviewer

WHAT ACTUALLY HAPPENS DURING THE JOB INTERVIEW PROCESS?

An interview is a meeting between a person who is seeking a job and a potential employer. The purpose of the interview is to discuss the applicant's qualifications in relation to the job. The interview consists of questions and answers from both participants. The interviewer asks questions to obtain information about the applicant and to find out about the person's general work attitude.

The applicant should express interest in the job and be willing to learn new things. Questions about the job or company should also be asked of the interviewer. A few important facts to find out during the interview would be the type of benefits the company offers, insurance coverage, the availability of sick leave and personal leave, the salary range and if there is a union.

Assist students in developing a list of tips to remember...

Prior to the interview

----Be 5 to 15 minutes early,
----Do not chew gum or smoke while waiting...

During the interview

----Avoid nervous gestures,
----Show self-confidence and determination...

Suggest that students keep a record of each interview to help remember facts about that job.

Students might also write a brief follow-up letter after the interview to express continued interest and to express appreciation for the interviewer's time.

AFTER SECURING EMPLOYMENT, HOW ARE JOBS KEPT?

After finding a job, the student's next concern will be to keep it. Many times this is the most difficult part of the job process. For this reason, it is imperative to discuss with students job responsibilities and attitudes that are necessary for keeping a job.

Below are examples of desirable job responsibilities and attitudes which will aid the student in getting along with superiors and co-workers on the job. Continual practice of such desirable characteristics should help ensure that a student will keep a job.

1. Being on time
2. Being at work every day
3. Maintaining neat appearance
4. Being responsible
5. Being friendly, but not overly friendly or too familiar with supervisors
6. Being courteous
7. Being honest
8. Showing respect for others
9. Not gossiping
10. Following directions
11. Keeping busy
12. Not making fun of others
13. Staying healthy
14. Following rules of the company
15. Taking an interest in your work
16. Leaving troubles at home
17. Taking pride in your work
18. Not arguing with the boss
19. Following safety procedures
20. Accepting criticism

Brainstorm with students other items which might be inincluded on the list of topics.

Students should be made aware that people are sometimes fired from their jobs. Below are a few examples of the poor work habits which lead to being fired.

1. Not being on time
2. Leaving early
3. Taking too many breaks
4. Taking too long on breaks
5. Missing days from work
6. Stealing from the company
7. Being dishonest
8. Breaking rules of the company
9. Not trying to get along with co-workers
10. Not maintaining work load
11. Lack of interest in learning new skills
12. Job not done well
13. Unwilling to improve work habits

Brainstorm with students other poor work habits that could lead to being fired.

Once students have been familiarized with the concepts provided in this section, he or she should have ample information necessary to become a productive member of the work force.

If a student has become a reliable worker and shows all the necessary qualifications, he/she may be chosen for career advancements. The following tips will prepare the student for job advancement.

1. Be efficient
2. Follow safety rules
3. Show responsibility
4. Work overtime, if necessary
5. Volunteer for extra duties
6. Take extra courses, workshops or seminars

HOW CAN EMPLOYABILITY SKILLS BE IMPLEMENTED INTO YOUR PROGRAM

The process of implementing employability skills into vocational programs can be viewed in relation to the philosophies of Prossor and Dewey.

Dr. C. A. Prossor, one of vocational education's founding fathers, contended that instructional content be focused on industry needs and that instructional methods be based on learning through direct experience. Prossor further expressed that by introducing students to a stimuli directly related to their desired occupational field and that by having them repeatedly react to that exact stimulus, learning would be fostered.

Dr. John Dewey, asserted that students learn better through a wholistic instructional approach which focuses on both occupational and personal survival skills.

In determining how to incorporate employability skills into your program, the most beneficial approach for nurturing learning is a blending of both the Prossor and Dewey philosophies with those of your own. The main thing to remember in determining your style is to make sure it encompasses goals beneficial both to students and to society. By using employability skills as stimuli and by having students practice those skills, they will be more productive as individuals and more productive as functioning members of society.

When incorporating employability skills into your program, the following 12 topics might be considered.*

1. Working in an Organization: To familiarize students with the reasons for the formation of organizations and the common characteristics of organizations.

2. Understanding Self and Others: To have students develop insights into causes of human behavior

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*Abstracted from the article, "Survival Skills: Mastering the Human Aspects of Work," by Robert E. Nelson, American Vocational Journal, November 1977.

and learn to interpret their own behavior and the behavior of others.

3. Motivation for Work: To have students develop an understanding of motivations into the work they perform.

4. Interpersonal Relations: To have students develop concepts and skills in interpersonal relations and apply them to work situations.

5. On-the-Job Communications: To have students understand the importance of effective communication and learn ways of communicating effectively on the job.

6. Using Creativity on the Job: To make students aware of their creative potential and to practice using their creative ability in hypothetical on-the-job situations.

7. Authority and Responsibility: To have students develop an understanding of the concepts of authority, power, influence, and responsibility as they apply to work situations.

8. Problem Solving: To have students develop skill in applying problem solving to their work.

9. Coping with Organizational Change: To make students aware of the process of organizational change and to suggest the techniques for coping with organizational change.

10. Coping with Organizational Conflict: To make students aware of the sources and types of conflict encountered on the job and recognize ways of coping with conflicts in an organization.

11. Leadership: To have students recognize the need for leadership in work groups and increase their understanding of the leadership role in work situations.

12. Adapting and Planning for the Future: To have students develop perspectives of work in the future and the ability to plan for anticipated changes in their work roles.

The two situations provided on the following pages represent suggested potential methods for implementing and nurturing employability skills into your own classroom environment. Both situations have successfully been used by instructors.

SITUATION 1: THE PERSONNEL ORGANIZATION

After the basic employability skills have been presented to and discussed with your students, you may find it helpful to reinforce those concepts by actually practicing them. In his book, Leadership Through Supervision in Industrial Education, Morris J. Ruley suggests a method for teaching employability skills in which all students assume, at some time during the program, managerial roles within a "personnel organization". The personnel organization gives students a sense of purpose and importance as individuals and as responsible members of a workforce. Ruley utilized the following offices for his "personnel organization."

SHOP SUPERINTENDENT: oversees the entire personnel system, checks cleanup, dismisses class, receives ideas and suggestions from class members, keeps a list of needed materials and supplies, keeps a responsibility chart up-to-date and confers with the instructor on matters pertaining to the welfare of the class.

SAFETY ENGINEER: checks all machine guards, sees that all students perform their work according to prescribed safety regulations, sees that all health and safety precautions are observed, keeps a constant check on first aid supplies, reports on injury immediately and reports any safety suggestions or hazards to the instructor.

SHOP FOREMAN: oversees all cleanup personnel, makes substitutions for absent cleanup members, improvises and receives ideas for improving cleanup procedure, checks all cleanup and reports to the superintendent when it is satisfactorily completed.

PERSONNEL DIRECTOR: checks roll, keeps the planning center in good order, checks over project files at the end of the period, checks library books and magazines out to the class and keeps a supply of plan sheets and job sheets.

PUBLIC RELATIONS DIRECTOR: responsible for display cases within the shop and show cases out of the shop area, writes any articles for the school paper and confers with the instructor on items of school and community relations.

STOCK-ROOM DIRECTOR: issues materials and supplies as requested by the instructor and keeps supplies in order.

MAINTENANCE DIRECTOR: instructs students in cleanup routine, sees that students perform duties as assigned and report to shop foreman at the end of the period.

FINISHING MANAGER: takes care of finishing supplies; keeps a constant check on all paint, varnish and shellac; keeps finishing cabinet and bench in neat and proper order; and reports any needed finishing supplies to the superintendent.

TOOL CLERK: checks all tools at end of the period and reports any missing, keeps track of all Tool Out Sheets, inspects all tools and keeps them in working order and keeps tool boards and tool cabinets in good order.

Ruley, Morris J. Leadership Through Supervision In Industrial Education. Bloomington, IL: McKnight & McKnight Publishing Company, 1971.

SITUATION 2: THE BUSINESS CORPORATION

Another method which has successfully been used to reinforce employability skills is by establishing the business corporation which is run by the students and monitored by the instructor.

Students in the Construction program at Gilmer High School in Ellijay, Georgia, have recently established a business corporation in which they will be building a house (minus plumbing and electrical work.) Financial transactions for this project were arranged by a local bank, school administrators and owners of a local building supply company.

The house, which is to be finished by the end of the school year, will be sold by the bank to any prospective buyer. The corporation will be dissolved when the project is accomplished.

Construction students are responsible for estimating the amount of needed materials, obtaining pricing information for all needed materials, filling out requisition forms, staying within the designated budget and building a house which conforms to industry standards and specifications.

Although the Construction program is the nucleus of this project, other programs are also benefitting. Business Education students are responsible for processing all purchase orders and other project related business communications.

Additionally, students in the Computer program are responsible for keeping a running invoice for all expenses incurred during the project and Health Occupations students are equipped to handle any minor injuries which may occur on the job.

Of course, a project such as this requires a good relationship among school personnel, students and members of the community. For this particular project, program advisory committees, architects, bankers, owners of building supply companies and interior decorators played a key advisory role in the formation of this corporation. Without this unique rapport, the continuation of this project as well as the promotion of future projects would not be possible.

TASK LISTING

TASK LISTING

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TASK LISTING INTRODUCTION

This section provides the task listing for the Electromechanical Technology program. The task listing is organized into two matrices which illustrate the relationship of each curriculum guide task to the Georgia developed instructional materials, to the D.O.T. Code exit points, to the competencies required for employment in a specific job area and to the Georgia competency based education (CBE) requirements.

If a task is applicable to a D.O.T Code exit point, competency or CBE requirement, an X appears where the columns intersect. For tasks having a related Georgia developed instructional unit, the number is provided in the column labeled UNIT.

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

V-4

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

			POSSIBLE EXIT POINTS																		
		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
TASK NO.	**TASK NAME**	**UNIT** / DOT NO.	824.261-014	829.684-022	824.681-010	637.68[illegible]-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
EE-01	Observing electrical safety precautions	EL-01		X		X					X	X									
EE-02	Identifying and using hand tools			X		X					X	X									
EE-03	Understanding the nature of matter	EL-01		X		X					X	X									
EE-04	Identifying sources of electricity	EL-01		X		X					X	X									
EE-05	Identifying circuit fundamentals	EL-04		X		X					X	X									
EE-06	Performing soldering and circuit fabrication			X		X					X	X									
EE-07	Understanding the fundamentals of resistance	EL-03		X								X									

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
	DOT DESCRIPTIONS / DOT NO.		824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
EE-08	Measuring voltage with a meter	EL-02 EL-08		X		X						X									
EE-09	Measuring current with a meter	EL-02 EL-08		X		X						X									
EE-10	Calculating power in circuits	EL-04		X								X									
EE-11	Identifying conductors and insulators			X	X	X					X	X									
EE-12	Making calculations using Ohm's Law	EL-02		X								X									
EE-13	Analyzing a series circuit	EL-04		X																	
EE-14	Analyzing a parallel circuit	EL-04		X																	
EE-15	Analyzing series-parallel circuits	EL-04		X																	
EE-16	Applying fundamentals of magnetism			X																	

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

		POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	MH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.667-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
EE-17	Demonstrating a knowledge of motors	EL-18		X		X						X									
EE-18	Demonstrating a knowledge of generation			X																	
EE-19	Using alternating current principles	EL-08		X		X						X									
EE-20	Demonstrating a knowledge of inductance	EL-08																			
EE-21	Determining inductive reactance	EL-08																			
EE-22	Demonstrating a knowledge of capacitance	EL-08		X																	
EE-23	Computing RC time circuits	EL-08																			
EE-24	Calculating capacitive reactance																				
EE-25	Analyzing RCL series circuits																				

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
EE-26	Analyzing RCL parallel circuits																				
EE-27	Analyzing the PN junction																				
EE-28	Analyzing special semiconductor diodes																				
EE-29	Using the oscilloscope			X																	
EE-20	Analyzing rectifiers			X																	
EE-31	Identifying and analyzing filters			X																	

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - MECHANICS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
M-01	Performing scientific calculations			X		X		X	X		X	X		X	X						
M-02	Calculating the mechanical advantage of the lever							X	X												
M-03	Using the lever							X	X												
M-04	Calculating the mechanical advantage of the wheel and axle							X	X												
M-05	Using the wheel and axle							X	X												
M-06	Calculating the mechanical advantage of the inclined plane and wedge							X	X												

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - MECHANICS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.J.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
	POSSIBLE EXIT POINTS DOT NO.		824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
M-07	Using the wedge							X	X												
M-08	Transmitting and calculating force and motion with the screw thread							X	X												
M-09	Using the screw							X	X												
M-10	Calculating the mechanical advantage of the pulley system							X	X												

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - FLUID POWER

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
FP-01	Identifying safety precautions when working on hydraulic/pneumatic systems							X	X						X						
FP-02	Defining hydraulics and pneumatics							X	X						X						
FP-03	Explaining the principles of hydraulics and pneumatics							X	X						X						
FP-04	Identifying fluid power symbols														X						
FP-05	Reading hydraulic and pneumatic schematic diagrams														X						

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - FLUID POWER

TASK NO.	TASK NAME	UNIT	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak T[illegible]	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
	POSSIBLE EXIT POINTS	DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	6[illegible]-010	710.281-0[illegible]8
FP-06	Recognizing hydraulic system basic components														X						
FP-07	Recognizing pneumatic system basic components														X						

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - EMPLOYABILITY SKILLS

		POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
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TASK NO.	TASK NAME	UNIT																			
ES-01	Discussing and demonstrating how to get a job		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ES-02	Discussing and demonstrating how to keep a job		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	824.261-014 Electrical Apprentice	829.684-022 Electrician Helper	824.681-010 Electrician	637.687-010 AC Inst. Ser. Helper	637.261-010 AC Inst. Ser., W.U.	638.684-018 Maint. Mech. Helper	899.684-022 Maint. Repair Helper	629.281-022 Elec. PL Maint. Mech.	827.584-010 Elec. Appl. Preparer	827.661-010 HH Appl. Installer	827.261-010 Elec. Appl. Servicer	637.684-010 Gas Appl. Ser. Helper	637.687-014 Ref. Mech. Helper	827.384-010 Refrigerator Tester	827.584-010 Gas Leak Tester	829.281-014 Electrical Repairer	630.281-010 Pneumatic Tool Repair	600.281-010 Fluid Power Mechanic	710.281-018 Electromech. Tech.
RW-01	Demonstrating a knowledge of the residential wiring occupation		X	X	X													X			
RW-02	Identifying electrical safety terms and practices		X	X	X													X			
RW-03	Identifying and using electrical wiring specialty tools		X	X	X													X			
RW-04	Using the National Electrical Code manual		X	X	X													X			
RW-05	Identifying conductors, cables and cords		X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
RW-06	Reading blueprints and rules	REW-12	X	X	X													X			
RW-07	Identifying and drawing electrical symbols used in residential wiring	REW-12	X	X	X													X			
RW-08	Identifying boxes and devices used in electrical wiring		X	X	X													X			
RW-09	Installing load centers		X	X	X													X			
RW-10	Identifying and installing overcurrent protection devices		X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
RW-11	Designing and installing lighting circuits	REW-03	X	X	X													X			
RW-12	Designing a circuit and installing a three-way switch	REW-06	X	X	X													X			
RW-13	Installing a 115v appliance outlet	REW-01	X	X	X													X			
RW-14	Installing a convenience outlet	REW-01	X	X	X													X			
RW-15	Installing a split switched receptacle	REW-04	X	X	X													X			
RW-16	Installing a one-button and a two-button door bell circuit	REW-05	X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
RW-17	Installing 230v circuits and outlets	REW-07	X	X	X													X			
RW-18	Installing a temporary service entrance	REW-10	X	X	X													X			
RW-19	Installing a service entrance	REW-08	X	X	X													X			
RW-30	Estimating materials for a given residential wiring installation	REW-13	X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

		POSSIBLE EXIT POINTS																			
		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.281-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
RF-01	Identifying career opportunities available in refrigeration	REF-01				X	X								X	X	X				
RF-02	Identifying safe working conditions	REF-02				X	X								X	X	X				
RF-03	Demonstrating a knowledge of basic refrigeration concepts	REF-03				X	X								X	X	X				
RF-04	Demonstrating a knowledge of the basic refrigeration cycle	REF-04				X	X								X	X	X				
RF-05	Identifying and using refrigeration tools	REF-05				X	X								X	X	X				

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

			POSSIBLE EXIT POINTS																		
		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
TASK NO.	TASK NAME	UNIT / DOT NO.	824.261-014	829.684-022	824.281-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
RF-06	Tapping, threading and replacing threads	REF-06				X	X								X						
RF-07	Identifying types of pipe and tube fittings used in refrigeration systems	REF-07				X	X								X	X					
RF-08	Performing basic copper tubing operations	REF-08				X	X								X	X					
RF-09	Swaging, cleaning, fluxing and soft soldering copper tubing	REF-09				X	X								X	X					
RF-10	Silver brazing refrigeration piping	REF-10				X	X								X	X					
RF-11	Handling, transforming, weighing and measuring refrigerants	REF-11				X	X								X	X	X				

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	DOT DESCRIPTIONS: Electrical Apprentice DOT NO.: 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
RF-12	Installing and using access valves	REF-12					X								X	X	X				
RF-13	Maintaining refrigeration manifold gauges	REF-13					X								X	X					
RF-14	Installing and using refrigeration mainfold gauges	REF-14					X								X	X					
RF-15	Evacuating a refrigeration system	REF-15				X	X								X	X	X				
RF-16	Installing refrigeration accessories	REF-16				X	X								X						
RF-17	Testing for leaks	REF-17				X	X								X	X	X				
RF-18	Charging a refrigeration system	REF-18				X	X								X	X	X				
RF-19	Troubleshooting refrigerator compressors	REF-19				X	X								X						

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

		POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
RF-20	Troubleshooting condensers	REF-20					X								X	X					
RF-21	Troubleshooting evaporators	REF-21					X								X	X					
RF-22	Troubleshooting an automatic expansion valve	REF-22					X								X	X					
RF-23	Troubleshooting capillary tubes	REF-23					X								X	X					
RF-24	Troubleshooting thermostatic expansion valves	REF-24					X								X	X					
RF-25	Troubleshooting the refrigeration system	REF-25				X	X								X	X					

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
RF-26	Installing a window air conditioning unit	REF-26				X	X														
RF-27	Performing pre-season start-up maintenance on window air conditioning units	REF-27				X	X														
RF-28	Troubleshooting compressor burnout in window air conditioners	REF-28					X								X	X					
RF-29	Evacuating and charging window air conditioners	REF-29				X	X								X	X					

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
RF-30	Troubleshooting fans and fan motors	REF-30				X	X								X	X					
RF-31	Troubleshooting mechanical problems in a window air conditioner refrigeration cycle	REF-31				X	X								X	X					
RF-32	Troubleshooting a window air conditioner electrical system	REF-32				X	X								X	X					
RF-33	Identifying and describing the function of refrigeration components	REF-33				X	X								X	X					

TASK LISTING BY DOT CODE

ELECTROMECANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

		POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.664-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
RF-34	Evacuating and charging domestic refrigerator and freezer systems	REF-34													X	X					
RF-35	Testing and replacing defective refrigeration cycle components	REF-35													X	X					
RF-36	Troubleshooting refrigerator/freezer compressor burnout	REF-36													X	X					
RF-37	Testing and repairing/replacing refrigerator/freezer fans and fan motors	REF-37													X	X					

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

		POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-010
TASK NO.	TASK NAME	UNIT																			
RF-38	Diagnosing problems in refrigerators and freezers	REF-38												X	X						

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. El Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-01	Developing troubleshooting plans for a major appliance			X							X	X	X	X			X	X			
MA-02	Installing and wiring an electric clothes dryer	MA-04		X							X	X	X	X			X	X			
MA-03	Troubleshooting and servicing electric dryer mechanical/electrical systems	MA-16		X							X	X	X	X			X	X			
MA-04	Installing, plumbing and wiring a clothes washer	MA-05		X							X	X	X	X			X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

		POSSIBLE EXIT POINTS — DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
MA-05	Troubleshooting and replacing the clothes washer water level control and door switches	MA-11 MA-15		X							X	X	X	X			X	X			
MA-06	Troubleshooting and replacing the clothes washer timer and solenoids	MA-11 MA-15		X							X	X	X	X			X	X			
MA-07	Troubleshooting and replacing the clothes washer motor and relay	MA-11 MA-15		X							X	X	X	X			X	X			
MA-08	Troubleshooting and replacing the clothes washer drain pump	MA-11 MA-15		X							X	X	X	X			X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
MA-09	Troubleshooting and replacing/repairing the clothes washer clutch and transmission	MA-11 MA-15		X							X	X	X	X			X	X			
MA-10	Installing, wiring and plumbing an electric water heater			X							X	X	X	X			X	X			
MA-11	Troubleshooting and replacing electric water heater elements			X							X	X	X	X			X	X			
MA-12	Troubleshooting and replacing electric water heater thermostats			X							X	X	X	X			X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
		UNIT																			
MA-13	Installing and wiring a trash compactor			X							X	X	X	X			X	X			
MA-14	Troubleshooting a trash compactor			X							X	X	X	X			X	X			
MA-15	Installing and wiring a microwave oven			X							X	X	X	X			X	X			
MA-16	Troubleshooting and repairing microwave ovens			X							X	X	X	X			X	X			
MA-17	Installing, wiring and plumbing a dishwasher	MA-06		X							X	X	X	X			X	X			
MA-18	Troubleshooting and replacing dishwasher water level control and door switches	MA-19		X							X	X	X	X			X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-19	Troubleshooting and replacing the dishwasher timer and solenoids	MA-18 MA-24		X							X	X	X	X			X	X			
MA-20	Troubleshooting and replacing the dishwasher motor and relay	MA-21		X							X	X	X	X			X	X			
MA-21	Troubleshooting and replacing or repairing the dishwasher drain pump	MA-23		X							X	X	X	X			X	X			
MA-22	Troubleshooting and replacing the dishwasher heating element and thermostat	MA-20		X							X	X	X	X			X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
MA-23	Troubleshooting and replacing the dishwasher automatic dispenser	MA-22		X							X	X	X	X	X	X	X	X			
MA-24	Installing and wiring an electric range, surface unit or wall oven	MA-01 MA-03		X							X	X	X	X	X	X	X	X			
MA-25	Troubleshooting and replacing surface unit and oven heating elements	MA-26 MA-28		X							X	X	X	X	X	X	X	X			
MA-26	Troubleshooting and replacing surface unit and oven temperature control switches and thermostats	MA-29		X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	UNIT	824.261-014 Electrical Apprentice	829.684-022 Electrician Helper	824.681-010 Electrician	637.687-010 AC Inst. Ser. Helper	637.261-010 AC Inst. Ser., W.U.	638.684-018 Maint. Mech. Helper	899.684-022 Maint. Repair Helper	629.281-022 Elec. PL Maint. Mech.	827.584-010 Elec. Appl. Preparer	827.661-010 HH Appl. Installer	827.261-010 Elec. Appl. Servicer	637.684-010 Gas Appl. Ser. Helper	637.687-014 Ref. Mech. Helper	827.384-010 Refrigerator Tester	827.584-010 Gas Leak Tester	829.281-014 Electrical Repairer	630.281-010 Pneumatic Tool Repair	600.281-010 Fluid Power Mechanic	710.281-018 Electromech. Tech.
MA-27	Troubleshooting and replacing the electric oven timer	MA-03		X							X	X	X	X	X	X	X	X			
MA-28	Installing and wiring a cook top and vent	MA-03		X							X	X	X	X	X	X	X	X			
MA-29	Troubleshooting ceramic or conventional cook tops	MA-03		X							X	X	X	X	X	X	X	X			
MA-30	Identifying and describing the function of the refrigeration components	REF-03		X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-31	Installing and wiring a refrigerator and/or freezer	MA-08		X							X	X	X	X	X	X	X	X			
MA-32	Troubleshooting and replacing refrigeration components	REF-35		X							X	X	X	X	X	X	X	X			
MA-33	Evacuating and charging domestic refrigerator and freezer systems	REF-34		X							X	X	X	X	X	X	X	X			
MA-34	Troubleshooting and replacing electrical components of a refrigerator and/or freezer	REF-38		X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-35	Installing and plumbing a gas clothes dryer			X							X	X	X	X	X	X	X	X			
MA-36	Troubleshooting and servicing gas clothes dryer mechanical/electrical systems			X							X	X	X	X	X	X	X	X			
MA-37	Troubleshooting, replacing and adjusting dryer gas controls			X							X	X	X	X	X	X	X	X			
MA-38	Installing and plumbing a gas water heater			X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. Pl. Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-39	Troubleshooting and replacing gas water heater relief valves			X							X	X	X	X	X	X	X	X			
MA-40	Troubleshooting, replacing and adjusting water heater gas controls			X							X	X	X	X	X	X	X	X			
MA-41	Troubleshooting and replacing gas water heater thermostats			X							X	X	X	X	X	X	X	X			
MA-42	Installing and plumbing a gas range or a wall oven and surface unit			X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-43	Troubleshooting and replacing gas range controls			X							X	X	X	X	X	X	X	X			
MA-44	Troubleshooting and replacing gas oven controls			X							X	X	X	X	X	X	X	X			
MA-45	Troubleshooting and replacing gas/ electric controls			X							X	X	X	X	X	X	X	X			
MA-46	Troubleshooting gas lines and connections for leaks			X							X	X	X	X	X	X	X	X			
MA-47	Installing a gas orifice			X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
MA-48	Adjusting pilot lights			X							X	X	X	X	X	X	X	X			
MA-49	Adjusting the gas burner			X							X	X	X	X	X	X	X	X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
IE-01	Identifying hazardous wiring locations		X	X	X													X			
IE-02	Locating service entrance equipment and writing specifications		X	X	X													X			
IE-03	Calculating and selecting service conduits		X	X	X													X			
IE-04	Installing service conduits		X	X	X													X			
IE-05	Installing outlet, junction boxes and conduit		X	X	X													X			
IE-06	Installing conduit under a concrete slab		X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
IE-07	Calculating branch circuit conductors and overcurrent protection		X	X	X													X			
IE-08	Determining sizes and types of feeder and overcurrent protection devices		X	X	X													X			
IE-09	Selecting and installing a 480v208-210 three phase four wire service entrance		X	X	X													X			
IE-10	Installing branch circuits and controls for air conditioning and heating		X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

			POSSIBLE EXIT POINTS																		
		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
IE-11	Installing branch circuits and controls for lighting		X	X	X													X			
IE-12	Calculating the 120 and 277 volt lighting load		X	X	X													X			
IE-13	Selecting and installing a 277 volt fluorescent light		X	X	X													X			
IE-14	Hooking up a three phase booster transformer		X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
IE-15	Making calculations for electric motors, welders and heaters		X	X	X													X			
IE-16	Identifying motor leads		X	X	X													X			
IE-17	Operating a capacitor start motor		X	X	X													X			
IE-18	Operating a three phase induction motor		X	X	X													X			

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
HP-01	Selecting reservoirs used in hydraulic systems																		X	X	
HP-02	Selecting and installing lines, fittings and couplers used in hydraulic/pneumatic systems																		X	X	
HP-03	Selecting and installing seals used in hydraulic/pneumatic systems																		X	X	
HP-04	Selecting and installing pumps used on hydraulic systems																		X	X	

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - HYDRAULICS AND PNEUMATICS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
	DOT DESCRIPTIONS / DOT NO.		824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
HP-05	Identifying and describing the properties of different hydraulic fluids																		X	X	
HP-06	Preventing hydraulic and pneumatic system contamination																		X	X	
HP-07	Selecting and installing cylinders used in hydraulic/pneumatic systems																		X	X	
HP-08	Selecting and installing valves on hydraulic/pneumatic systems																		X	X	

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
HP-09	Identifying basic hydraulic/pneumatic circuits																		X	X	
HP-10	Selecting and installing compressors used on a pneumatic system																		X	X	
HP-11	Selecting and installing motors used in hydraulic/pneumatic systems																		X	X	
HP-12	Selecting and installing accessories used on a pneumatic system																		X	X	

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	**TASK NAME**	**UNIT**																			
HP-13	Selecting and installing accessories																		X	X	
HP-14	Planning the maintenance of a hydraulic system																		X	X	
HP-15	Planning the maintenance of a pneumatic system																		X	X	

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - COMPUTER TECHNOLOGY

POSSIBLE EXIT POINTS

		DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
C-01	Understanding computer arithmetic									X											X
C-02	Understanding microprocessor hardware									X											X
C-03	Understanding the functions of a computer									X											X
C-04	Using the microcomputer									X											X
C-05	Analyzing microcomputer circuits									X											X

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - NUMERICAL CONTROLS

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	UNIT	Electrical Apprentice 824.261-014	Electrician Helper 829.684-022	Electrician 824.681-010	AC Inst. Ser. Helper 637.687-010	AC Inst. Ser., W.U. 637.261-010	Maint. Mech. Helper 638.684-018	Maint. Repair Helper 899.684-022	Elec. PL Maint. Mech. 629.281-022	Elec. Appl. Preparer 827.584-010	HH Appl. Installer 827.661-010	Elec. Appl. Servicer 827.261-010	Gas Appl. Ser. Helper 637.684-010	Ref. Mech. Helper 637.687-014	Refrigerator Tester 827.384-010	Gas Leak Tester 827.584-010	Electrical Repairer 829.281-014	Pneumatic Tool Repair 630.281-010	Fluid Power Mechanic 600.281-010	Electromech. Tech. 710.281-018
NC-01	Operating programmable controllers									X											X
NC-02	Operating solid state logic motor controls									X											X
NC-03	Understanding instrumentation for programmable controllers									X											X
NC-04	Interfacing a microcomputer with peripherals									X											X
NC-05	Using the microcomputer as a controller									X											X

TASK LISTING BY DOT CODE

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - ROBOTICS

		POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Electrical Apprentice	Electrician Helper	Electrician	AC Inst. Ser. Helper	AC Inst. Ser., W.U.	Maint. Mech. Helper	Maint. Repair Helper	Elec. PL Maint. Mech.	Elec. Appl. Preparer	HH Appl. Installer	Elec. Appl. Servicer	Gas Appl. Ser. Helper	Ref. Mech. Helper	Refrigerator Tester	Gas Leak Tester	Electrical Repairer	Pneumatic Tool Repair	Fluid Power Mechanic	Electromech. Tech.
		DOT NO.	824.261-014	829.684-022	824.681-010	637.687-010	637.261-010	638.684-018	899.684-022	629.281-022	827.584-010	827.661-010	827.261-010	637.684-010	637.687-014	827.384-010	827.584-010	829.281-014	630.281-010	600.281-010	710.281-018
TASK NO.	TASK NAME	UNIT																			
R-01	Comparing robotic systems									X											X
R-02	Installing a robot									X											X
R-03	Designing a work cell									X											X
R-04	Scheduling robot work assignments									X											X
R-05	Repairing and maintaining robotic systems									X											X

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

V-49

TASK NO.	TASK NAME	COMPETENCIES	Identifying electrical/electronics parts	Troubleshooting circuits	Replacing faulty components	Troubleshooting generator circuitry	Servicing and replacing bearings					CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
EE-01	Observing electrical safety precautions			X	X	X	X						X	X	X				
EE-02	Identifying and using hand tools			X	X	X	X						X	X	X				
EE-03	Understanding the nature of matter			X									X	X	X				
EE-04	Identifying sources of electricity		X			X							X	X	X				
EE-05	Identifying circuit fundamentals		X		X								X	X	X				
EE-06	Performing soldering and circuit																		
	fabrication			X	X								X	X	X				
EE-07	Understanding the fundamentals of																		
	resistance			X									X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

TASK NO.	TASK NAME	COMPETENCIES: Identifying electrical/electronics parts	Troubleshooting circuits	Testing armature	Testing field	Troubleshooting generator circuitry	Testing rectifiers	Replacing diodes	Replacing full and half bridges	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
EE-08	Measuring voltage with a meter		X	X	X	X	X	X	X	X	X	X		
EE-09	Measuring current with a meter		X	X	X	X	X	X	X	X	X	X		
EE-10	Calculating power in circuits		X							X	X	X		
EE-11	Identifying conductors and insulators	X	X							X	X	X		
EE-12	Making calculations using Ohm's Law		X							X	X	X		
EE-13	Analyzing a series circuit	X	X							X	X	X		
EE-14	Analyzing a parallel circuit	X	X							X	X	X		
EE-15	Analyzing a series-parallel circuit	X	X							X	X	X		
EE-16	Applying fundamentals of magnetism		X	X	X					X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

		COMPETENCIES										CBE REQUIREMENTS MET						
TASK NO.	TASK NAME	Testing field	Troubleshooting motor circuitry	Servicing and replacing bearings	Installing/wiring electric motors	Troubleshooting generator circuitry	Installing/wiring generators	Testing filters and filter circuits	Replacing capacitors	Testing timer circuits	Servicing timer circuits	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
EE-17	Demonstrating a knowledge of motors	X	X	X	X							X	X	X				
EE-18	Demonstrating a knowledge of generation					X	X					X	X	X				
EE-19	Using alternating current principles					X	X					X	X	X				
EE-20	Demonstrating a knowledge of inductance					X	X					X	X	X				
EE-21	Determining inductive reactance							X	X			X	X	X				
EE-22	Demonstrating a knowledge of capacitance							X	X			X	X	X				
EE-23	Computing RC time constants									X	X	X	X	X				
EE-24	Calculating capacitive reactance							X	X	X	X	X	X	X				
EE-25	Analyzing RCL series circuits							X	X	X	X	X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - ELECTRICITY/ELECTRONICS

TASK NO.	TASK NAME	COMPETENCIES	Testing rectifiers	Replacing diodes	Testing filters and filter circuits	Replacing capacitors	Testing timer circuits	Servicing timer circuits				CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
EE-26	Analyzing RCL parallel circuits		X	X	X	X	X	X					X	X	X				
EE-27	Analyzing the PN junction		X	X			X	X					X	X	X				
EE-28	Analyzing special semiconductor diodes		X	X			X	X					X	X	X				
EE-29	Using the oscilloscope		X	X	X	X	X	X					X	X	X				
EE-30	Analyzing rectifiers		X	X									X	X	X				
EE-31	Identifying and analyzing filters				X	X							X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - MECHANICS

TASK NO.	TASK NAME	COMPETENCIES: Analyzing transmission problems	Repairing transmission problems	Installing and adjusting transmission	Analyzing pulley problems	Servicing pulley systems	Installing and adjusting pulley systems	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
M-01	Performing scientific calculations	X	X	X	X	X	X	X	X	X		
M-02	Calculating the mechanical advantage of the lever	X	X	X	X	X	X	X	X	X		
M-03	Using the lever				X	X	X	X	X	X		
M-04	Calculating the mechanical advantage of the wheel and axle	X	X	X	X	X	X	X	X	X		
M-05	Using the wheel and axle	X	X	X	X	X	X	X	X	X		
M-06	Calculating the mechanical advantage of the inclined plane and wedge	X	X	X	X	X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - MECHANICS

		COMPETENCIES						CBE REQUIREMENTS MET				
TASK NO.	TASK NAME	Analyzing transmission problems	Repairing transmission problems	Installing and adjusting transmission	Analyzing pulley problems	Servicing pulley problems	Installing and adjusting pulley problems	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
M-07	Using the wedge	X	X	X				X	X	X		
M-08	Transmitting and calculating force and motion with the screw thread	X	X	X	X	X	X	X	X	X		
M-09	Using the screw	X	X	X				X	X	X		
M-10	Calculating the mechanical advantage of the pulley system				X	X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - FLUID POWER

TASK NO.	TASK NAME	COMPETENCIES: Explaining principles of hydraulics	Explaining principles of pneumatics	Reading hydraulic/pneumatic schematic diagrams	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
FP-01	Identifying safety precautions when working on hydraulic/pneumatic systems	X	X		X	X	X		
FP-02	Defining hydraulics and pneumatics	X	X		X	X	X		
FP-03	Explaining the principles of hydraulics and pneumatics	X	X		X	X	X		
FP-04	Identifying fluid power symbols			X	X	X	X		
FP-05	Reading hydraulic and pneumatic schematic diagrams			X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - FLUID POWER

		COMPETENCIES	CBE REQUIREMENTS MET				
TASK NO.	TASK NAME	Recognizing hydraulic/pneumatic basic components	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
FP-06	Recognizing hydraulic system basic components	X	X	X	X		
FP-07	Recognizing pneumatic system basic components	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CORE CURRICULUM - EMPLOYABILITY SKILLS

TASK NO.	TASK NAME	COMPETENCIES		CBE REQUIREMENTS MET				
		Obtaining a job	Holding a job	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
ES-01	Discussing and demonstrating how to get a job	X		X	X	X		
ES-02	Discussing and demonstrating how to keep a job		X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

TASK NO.	TASK NAME	COMPETENCIES: Obtaining a job	Installing wiring	Installing service entrance	Installing wall outlets	Installing switches	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RW-01	Demonstrating a knowledge of the residential wiring occupation	X					X	X	X		
RW-02	Identifying electrical safety terms and practices		X				X	X	X		
RW-03	Identifying and using electrical wiring specialty tools		X				X	X	X		
RW-04	Using the National Electrical Code manual		X	X	X	X	X	X	X		
RW-05	Identifying conductors, cables and cords		X	X			X	X	X		

TASK LISTING BY COMPETENCY
AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

TASK NO.	TASK NAME	COMPETENCIES					CBE REQUIREMENTS MET				
		Installing wiring	Installing service entrance	Installing wall outlets	Installing switches	Wiring for major appliances	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RW-06	Reading blueprints and rules	X	X	X	X		X	X	X		
RW-07	Identifying and drawing electrical symbols used in residential wiring	X	X	X	X		X	X	X		
RW-08	Identifying boxes and devices used in electrical wiring		X	X	X		X	X	X		
RW-09	Installing load centers		X				X	X	X		
RW-10	Identifying and installing overcurrent protection devices		X			X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

TASK NO.	TASK NAME	COMPETENCIES				CBE REQUIREMENTS MET				
		Installing wiring	Installing wall outlets	Installing switches	Testing and repairing wiring and switches	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RW-11	Designing and installing lighting circuits	X		X	X	X	X	X		
RW-12	Designing a circuit and installing a three-way switch	X		X	X	X	X	X		
RW-13	Installing a 115v appliance outlet	X	X		X	X	X	X		
RW-14	Installing a convenience outlet	X	X			X	X	X		
RW-15	Installing a split switched receptacle	X		X	X	X	X	X		
RW-16	Installing a one-button and a two-button door bell circuit	X			X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION -
RESIDENTIAL ELECTRICAL WIRING

TASK NO.	TASK NAME	COMPETENCIES					CBE REQUIREMENTS MET				
		Installing wiring	Installing service entrance	Wiring for major appliances	Installing wall outlets	Installing switches	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RW-17	Installing 230v circuits and outlets	X		X			X	X	X		
RW-18	Installing a temporary service entrance		X				X	X	X		
RW-19	Installing a service entrance		X				X	X	X		
RW-20	Estimating materials for a given residential wiring installation	X	X	X	X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	COMPETENCIES	Testing/repairing compressor units	Recharging refrigeration units	Testing/repairing electrical components	Obtaining a job						CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
RF-01	Identifying career opportunities					X							X	X	X				
	available in refrigeration		X										X	X	X				
RF-02	Identifying safe working conditions		X										X	X	X				
RF-03	Demonstrating a knowledge of basic																		
	refrigeration concepts		X										X	X	X				
RF-04	Demonstrating a knowledge of the basic																		
	refrigeration cycle			X	X								X	X	X				
RF-05	Identifying and using refrigeration																		
	tools		X		X								X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	Testing/repairing compressor units	Recharging refrigeration units	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RF-06	Tapping, threading and replacing threads	X		X	X	X		
RF-07	Identifying types of pipe and tube fittings used in refrigeration systems	X	X	X	X	X		
RF-08	Performing basic copper tubing operations	X		X	X	X		
RF-09	Swaging, cleaning, fluxing and soft soldering copper tubing	X		X	X	X		
RF-10	Silver brazing refrigeration piping	X		X	X	X		
RF-11	Handling, transforming, weighing and measuring refrigerants		X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	COMPETENCIES		CBE REQUIREMENTS MET				
		Testing/repairing compressor units	Recharging refrigeration units	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RF-12	Installing and using access valves	X	X	X	X	X		
RF-13	Maintaining refrigeration manifold gauges	X	X	X	X	X		
RF-14	Installing and using refrigeration manifold gauges	X	X	X	X	X		
RF-15	Evacuating a refrigeration system	X	X	X	X	X		
RF-16	Installing refrigeration accessories	X	X	X	X	X		
RF-17	Testing for leaks	X	X	X	X	X		
RF-18	Charging a refrigeration system	X	X	X	X	X		
RF-19	Troubleshooting refrigerator compressors	X		X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	COMPETENCIES	Testing/repairing compressor units									CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
RF-20	Troubleshooting condensers		X										X	X	X				
RF-21	Troubleshooting evaporators		X										X	X	X				
RF-22	Troubleshooting an automatic expansion valve		X										X	X	X				
RF-23	Troubleshooting capillary tubes		X										X	X	X				
RF-24	Troubleshooting thermostatic expansion valves		X										X	X	X				
RF-25	Troubleshooting the refrigeration system		X										X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	Installing air conditioning units	Testing/repairing compressor units	Recharging air conditioning units	Installing and wiring ducting	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
		COMPETENCIES				**CBE REQUIREMENTS MET**				
RF-26	Installing a window air conditioning unit	X			X	X	X	X		
RF-27	Performing pre-season start-up maintenance on window air conditioning units	X				X	X	X		
RF-28	Troubleshooting compressor burnout in window air conditioners		X			X	X	X		
RF-29	Evacuating and charging window air conditioners			X		X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	Testing/repairing compressor units	Testing/repairing electrical components	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RF-30	Troubleshooting fans and fan motors		X	X	X	X		
RF-31	Troubleshooting mechanical problems in a window air conditioner refrigeration cycle		X	X	X	X		
RF-32	Troubleshooting a window air conditioner electrical system		X	X	X	X		
RF-33	Identifying and describing the function of refrigeration components	X		X	X	X		

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TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	COMPETENCIES			CBE REQUIREMENTS MET				
		Recharging refrigeration units	Testing/repairing compressor units	Testing/repairing electrical components	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
RF-34	Evacuating and charging domestic refrigerator and freezer systems	X			X	X	X		
RF-35	Testing and replacing defective refrigeration cycle components		X		X	X	X		
RF-36	Troubleshooting refrigerator/freezer compressor burnout		X		X	X	X		
RF-37	Testing and repairing/replacing refrigerator/freezer fans and fan motors			x	X	X	X		

TASK LISTING BY COMPETENCY

AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - REFRIGERATION

TASK NO.	TASK NAME	COMPETENCIES									CBE REQUIREMENTS MET						
		Testing/repairing compressor units									LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
RF-38	Diagnosing problems in refrigerators and freezers	X									X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	Installing wiring for electric dryer	Repairing/replacing parts of a dryer	Installing air duct for dryers	Installing plumbing and wiring for washer	Testing electric clothes dryer	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
MA-01	Developing troubleshooting plans for a major appliance					X	X	X	X		
MA-02	Installing and wiring an electric clothes dryer	X					X	X	X		
MA-03	Troubleshooting and servicing electric dryer mechanical/electrical systems		X				X	X	X		
MA-04	Installing, plumbing and wiring a clothes washer				X		X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

		COMPETENCIES			CBE REQUIREMENTS MET				
TASK NO.	TASK NAME	Testing/repairing timer and control circuits	Testing/repairing electric motors	Testing/repairing water pumps	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
MA-05	Troubleshooting and replacing the clothes washer water level control and door switches	X			X	X	X		
MA-06	Troubleshooting and replacing the clothes washer timer and solenoids	X			X	X	X		
MA-07	Troubleshooting and replacing the clothes washer motor and relay		X		X	X	X		
MA-08	Troubleshooting and replacing the clothes washer drain pump			X	X	X	X		

TASK LISTING BY COMPETENCY
AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES: Testing/repairing washer transmissions	Installing water heaters	Testing and repairing water heaters	Installing water heater plumbing and wiring						CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
MA-09	Troubleshooting and replacing/repairing the clothes washer clutch and transmission	X									X	X	X				
MA-10	Installing, wiring and plumbing an electric water heater		X		X						X	X	X				
MA-11	Troubleshooting and replacing electric water heater elements			X							X	X	X				
MA-12	Troubleshooting and replacing electric water heater thermostats			X							X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

		COMPETENCIES										CBE REQUIREMENTS MET						
TASK NO.	TASK NAME	Installing trash compactors	Testing/repairing compactor electric circuits	Testing/repairing compactor motors	Testing/repairing compactor sensors	Testing/repairing electrical circuits	Testing/repairing microprocessor	Testing/repairing sensors and safety switches	Installing dishwashers	Installing plumbing and wiring for dishwashers	Testing/repairing dishwasher electric circuits	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
MA-13	Installing and wiring a trash compactor	X										X	X	X				
MA-14	Troubleshooting a trash compactor		X	X	X							X	X	X				
MA-15	Installing and wiring a microwave oven					X						X	X	X				
MA-16	Troubleshooting and repairing microwave ovens						X	X				X	X	X				
MA-17	Installing, wiring and plumbing a dishwasher								X	X	X	X	X	X				
MA-18	Troubleshooting and replacing dishwasher water level control and door switches								X	X	X	X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES	Testing/repairing dishwasher electric circuits	Testing/repairing dishwasher pumps	Testing/repairing dishwasher heating elements	Replacing defective parts	Testing and replacing displays					CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
MA-19	Troubleshooting and replacing the dishwasher timer and solenoids		X			X	X						X	X	X				
MA-20	Troubleshooting and replacing the dishwasher motor and relay		X										X	X	X				
MA-21	Troubleshooting and replacing or repairing the dishwasher drain pump			X									X	X	X				
MA-22	Troubleshooting and replacing the dishwasher heating element and thermostat				X	X	X						X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

		COMPETENCIES					CBE REQUIREMENTS MET				
TASK NO.	TASK NAME	Testing/repairing dishwasher electrical circuits	Installing electric stove/ovens	Testing/repairing heating elements	Testing/repairing thermostats and circuits	Testing/repairing electrical controls and timers	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
MA-23	Troubleshooting and replacing the dishwasher automatic dispenser	X					X	X	X		
MA-24	Installing and wiring an electric range, surface unit or wall oven		X				X	X	X		
MA-25	Troubleshooting and replacing surface unit and oven heating elements			X			X	X	X		
MA-26	Troubleshooting and replacing surface unit and oven temperature control switches and thermostats				X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES: Testing/repairing electrical controls and timers	Installing electrical wiring for stove/ovens	Testing/repairing heating elements	Testing/repairing compressor units	Testing/repairing electrical components	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
MA-27	Troubleshooting and replacing the electric oven timer	X					X	X	X		
MA-28	Installing and wiring a cook top and vent		X				X	X	X		
MA-29	Troubleshooting ceramic or conventional cook tops			X			X	X	X		
MA-30	Identifying and describing the function of the refrigeration components				X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES	Installing refrigeration units	Testing/repairing compressor units	Recharging refrigeration units	Testing/repairing electrical components						CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
MA-31	Installing and wiring a refrigerator and/or freezer		X										X	X	X				
MA-32	Troubleshooting and replacing refrigeration components			X									X	X	X				
MA-33	Evacuating and charging domestic refrigerator and freezer systems				X								X	X	X				
MA-34	Troubleshooting and replacing electrical components of a refrigerator and/or freezer					X							X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES: Installing gas clothes dryer	Installing gas pipes for a dryer	Installing air duct for dryers	Testing gas clothes dryer	Repairing/replacing parts of a dryer	Installing gas water heaters	Testing and repairing water heaters	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
MA-35	Installing and plumbing a gas clothes dryer	X	X	X					X	X	X		
MA-36	Troubleshooting and servicing gas clothes dryer mechanical/electrical systems				X	X			X	X	X		
MA-37	Troubleshooting, replacing and adjusting dryer gas controls				X	X			X	X	X		
MA-38	Installing and plumbing a gas water heater						X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES		Testing and repairing water heaters	Installing gas/stove ovens	Installing gas pipe and wiring for stove/ovens							CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
MA-39	Troubleshooting and replacing gas water heater relief valves			X										X	X	X				
MA-40	Troubleshooting, replacing and adjusting water heater gas controls			X										X	X	X				
MA-41	Troubleshooting and replacing gas water heater thermostats			X										X	X	X				
MA-42	Installing and plumbing a gas range or a wall oven and surface unit				X	X								X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES: Testing/repairing thermostats and circuits	Testing/repairing electrical controls and timers	Testing/repairing gas burner	Installing gas pipe and wiring for stove/ovens						CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
MA-43	Troubleshooting and replacing gas range controls	X									X	X	X				
MA-44	Troubleshooting and replacing gas oven controls	X									X	X	X				
MA-45	Troubleshooting and replacing gas/ electric controls		X								X	X	X				
MA-46	Troubleshooting gas lines and connections for leaks				X						X	X	X				
MA-47	Installing a gas orifice			X							X	X	X				

TASK LISTING BY COMPETENCY

AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

V-81

CONSUMER APPLICATION - MAJOR APPLIANCES

TASK NO.	TASK NAME	COMPETENCIES	Installing gas stove/ovens	Testing/repairing gas burner	CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
MA-48	Adjusting pilot lights		X			X	X	X		
MA-49	Adjusting the gas burner		X	X		X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

V-82

TASK NO.	TASK NAME	COMPETENCIES: Installing service conduit	Installing wiring	Installing 280,208,210 three phase	Installing a service entrance	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
IE-01	Identifying hazardous wiring locations	X	X	X	X	X	X	X		
IE-02	Locating service entrance equipment and writing specifications				X	X	X	X		
IE-03	Calculating and selecting service conduits	X				X	X	X		
IE-04	Installing service conduits	X				X	X	X		
IE-05	Installing outlet, junction and conduit		X			X	X	X		
IE-06	Installing conduit under a concrete slab	X				X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

TASK NO.	TASK NAME	COMPETENCIES	Installing branch circuits and controls	Installing service entrance	Testing industrial wiring and equipment	Installing 480,208,210 three phase	Servicing industrial wiring and equipment					CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
IE-07	Calculating branch circuit conductors and overcurrent protection		X		X		X						X	X	X				
IE-08	Determining sizes and types of feeders and overcurrent protection devices		X	X	X		X						X	X	X				
IE-09	Selecting and installing 280v208-210 three phase four wire service entrance			X		X							X	X	X				
IE-10	Installing branch circuits and controls for air conditioning and heating		X										X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

		COMPETENCIES				CBE REQUIREMENTS MET				
TASK NO.	**TASK NAME**	Installing fluorescent light	Installing branch circuits and controls	Testing industrial wiring and equipment	Installing circuits for welders and heaters	**LEARNER**	**INDIVIDUAL**	**PRODUCER**	**CONSUMER**	**CITIZEN**
IE-11	Installing branch circuits and controls for lighting	X	X			X	X	X		
IE-12	Calculating the 120 and 277 volt lighting load	X		X		X	X	X		
IE-13	Selecting and installing a 277 volt fluorescent light	X				X	X	X		
IE-14	Hooking up a three phase booster transformer				X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - INDUSTRIAL ELECTRICITY

TASK NO.	TASK NAME	COMPETENCIES				CBE REQUIREMENTS MET				
		Installing electric motors	Installing circuits for welders and heaters	Servicing industrial wiring and equipment	Testing industrial wiring and equipment	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
IE-15	Making calculations for electric motors, welders and heaters	X	X	X	X	X	X	X		
IE-16	Identifying motor leads	X		X	X	X	X	X		
IE-17	Operating a capacitor start motor	X		X	X	X	X	X		
IE-18	Operating a three phase induction motor	X		X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

TASK NO.	TASK NAME	COMPETENCIES: Analyzing hydraulic system problems	Servicing hydraulic systems	Installing and adjusting hydraulic pumps	Installing and adjusting hydraulic lines	Installing and adjusting hydraulic gauges and controls	Analyzing pneumatic system problems	Installing and adjusting pneumatic pumps	Installing and adjusting pneumatic lines	Installing and adjusting pneumatic gauges and controls	Servicing pneumatic systems	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
HP-01	Selecting reservoirs used in hydraulic systems	X	X									X	X	X				
HP-02	Selecting and installing lines, fittings and couplers used in hydraulic/pneumatic systems			X	X	X	X	X	X	X		X	X	X				
HP-03	Selecting and installing seals used in hydraulic/pneumatic systems	X	X	X	X	X	X				X	X	X	X				
HP-04	Selecting and installing pumps used on hydraulic systems			X	X	X		X	X	X		X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

		COMPETENCIES						CBE REQUIREMENTS MET				
TASK NO.	TASK NAME	Analyzing hydraulic system problems	Servicing hydraulic systems	Analyzing pneumatic system problems	Servicing pneumatic systems	Installing and adjusting hydraulic gauges and controls	Installing and adjusting pneumatic gauges and controls	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
HP-05	Identifying and describing the properties of different hydraulic fluids	X	X	X	X			X	X	X		
HP-06	Preventing hydraulic and pneumatic system contamination	X	X	X	X			X	X	X		
HP-07	Selecting and installing cylinders used in hydraulic/pneumatic systems					X	X	X	X	X		
HP-08	Selecting and installing valves on hydraulic/pneumatic systems					X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

TASK NO.	TASK NAME	COMPETENCIES: Analyzing hydraulic system problems	Installing and adjusting pneumatic pumps	Installing and adjusting hydraulic gauges and controls	Installing and adjusting pneumatic gauges and controls	CBE REQUIREMENTS MET: LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
HP-09	Identifying basic hydraulic/pneumatic circuits	X	X			X	X	X		
HP-10	Selecting and installing compressors used on a pneumatic system				X	X	X	X		
HP-11	Selecting and installing motors used in hydraulic/pneumatic systems			X	X	X	X	X		
HP-12	Selecting and installing accessories used on a pneumatic system				X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION -
HYDRAULICS AND PNEUMATICS

TASK NO.	TASK NAME	COMPETENCIES	Installing and adjusting hydraulic lines	Installing and adjusting hydraulic gauges and controls	Servicing hydraulic systems	Servicing pneumatic systems						CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
HP-13	Selecting and installing accessories used on a hydraulic system		X	X									X	X	X				
HP-14	Planning the maintenance of a hydraulic system				X								X	X	X				
HP-15	Planning the maintenance of a pneumatic system					X							X	X	X				

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - COMPUTER TECHNOLOGY

TASK NO.	TASK NAME	COMPETENCIES	Installing computer equipment	Installing computer peripherals	Testing and start up	Installing electrical and cooling components	Testing computer CPU	Testing computer O/I boards	Replacing faulty parts	Testing and debugging software		CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
C-01	Understanding computer arithmetic		X	X	X	X	X	X	X	X	X		X	X	X	X			
C-02	Understanding microprocessor hardware		X	X	X	X	X	X	X	X	X		X	X	X	X			
C-03	Understanding the functions of a computer		X	X	X	X	X	X	X	X	X		X	X	X	X			
C-04	Using the microcomputer		X	X	X	X	X	X	X	X	X		X	X	X	X			
C-05	Analyzing microcomputer circuits		X	X	X	X	X	X	X	X	X		X	X	X	X			

TASK LISTING BY COMPETENCY
AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - NUMERICAL CONTROL

TASK NO.	TASK NAME		Testing computer operations	Testing interface circuits	Repairing faulty circuits	Testing machine sensing devices	Repairing/replacing sensors	Installing computer control device	Running start up tests	Installing the microprocessor	Debugging software	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN		
		COMPETENCIES										CBE REQUIREMENTS MET						
NC-01	Operating programmable controllers		X	X	X	X	X	X	X	X	X	X	X	X				
NC-02	Operating solid state logic motor controls		X	X	X	X	X	X	X	X	X	X	X	X				
NC-03	Understanding instrumentation for programmable controllers			X	X	X	X	X	X	X	X	X	X	X				
NC-04	Interfacing a microcomputer with peripherals			X	X	X	X	X	X	X	X	X	X	X				
NC-05	Using a microcomputer as a controller			X	X	X	X	X	X	X	X	X	X	X				

TASK LISTING BY COMPETENCY
AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

INDUSTRIAL APPLICATION - ROBOTICS

TASK NO.	TASK NAME	COMPETENCIES									CBE REQUIREMENTS MET				
			Testing robotic controllers	Testing robot components	Testing pneumatic robot controllers	Testing pneumatic robot components	Installing robot power supplies	Installing robot actuators	Testing start up procedure	Writing robot programs	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
R-01	Comparing robotic systems		X	X	X	X					X	X	X		
R-02	Installing a robot			X		X	X	X	X	X	X	X	X		

TASK LISTING BY COMPETENCY AND CBE REQUIREMENT

ELECTROMECHANICAL TECHNOLOGY

V-93

INDUSTRIAL APPLICATION - ROBOTICS

TASK NO.	TASK NAME	COMPETENCIES	Repairing/replacing end or arm tooling	Repairing controller and interface	Servicing hydraulic power supplies	Servicing pneumatic power supplies	Testing robot components	Testing pneumatic robot components	Servicing hydraulic actuators	Servicing pneumatic actuators	Writing robot programs	CBE REQUIREMENTS MET	LEARNER	INDIVIDUAL	PRODUCER	CONSUMER	CITIZEN
R-03	Designing a work cell		X				X	X	X	X	X		X	X	X		
R-04	Scheduling robot work assignments		X						X	X	X		X	X	X		
R-05	Repairing and maintaining robotic systems		X	X	X	X	X	X	X	X	X		X	X	X		

CURRICULUM STRUCTURE

CURRICULUM STRUCTURE

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Core Curriculum by Semester 5
Second Year Optional Areas 6

CURRICULUM STRUCTURE INTRODUCTION

On the following pages, a suggested curriculum structure for the Electromechanical Technology program is presented. A curriculum structure is a method for outlining the information to be presented in the program. The proposed curriculum structure is sectioned by core curriculum and optional area major blocks and by the duty areas within those blocks.

CORE CURRICULUM

QUARTER I

ELECTRICITY/ELECTRONICS	HOURS
Electricity/electronics fundamentals	79
Understanding circuits	33
	112

QUARTER II

ELECTRICITY/ELECTRONICS	
Understanding motors/generators	19
Understanding RCL circuits	31
Understanding electronic devices	52
	102

QUARTER III

MECHANICS	
Calculating mechanical advantage	48
Using mechanical advantages	10
FLUID POWER	
Fundamentals of hydraulics and pneumatics	35
EMPLOYABILITY SKILLS	
Employment skills	20
	113

CORE CURRICULUM

SEMESTER I

ELECTRICITY/ELECTRONICS

	HOURS
Electricity/electronics fundamental	79
Understanding circuits	33
Understanding motors/generators	20
Understanding RCL circuits	31
	162

SEMESTER II

ELECTRICITY/ELECTRONICS

Understanding electronic devices	52

MECHANICS

Calculating mechanical advantage	43
Using mechanical advantages	

FLUID POWER

Fundamentals of hydraulics and pneumatics	35

EMPLOYABILITY SKILLS

Employment skills	20
	165

SECOND YEAR OPTIONAL AREAS

RESIDENTIAL ELECTRICAL WIRING

Residential electrical wiring fundamentals	48
Ground outlets (115v - 230v)	74
Service entrance	24
	146

REFRIGERATION

Refrigeration fundamentals	39
Tubing and piping	12
Refrigerants	45
Troubleshooting	46
Window air conditioning	42
Refrigerators and freezers	44
	228

MAJOR APPLIANCES

Installing electric appliances	102
Troubleshooting electric appliances	310
Installing gas appliances	72
Troubleshooting gas appliances	123
	607

INDUSTRIAL ELECTRICITY

Fundamentals	16
Selecting and installing conduit	45
Selecting and installing branch circuits	40
Selecting and installing lighting circuits	28
Installing wiring for large equipment	44
	173

HYDRAULICS AND PNEUMATICS

Fundamentals of hydraulics and pneumatics	23
Installing and servicing hydraulic and pneumatic systems and equipment	55
Maintenance of hydraulic and pneumatic systems	10
	88

COMPUTER TECHNOLOGY

Understanding computers	75
Using computers	18
Analyzing computer problems	18
	111

NUMERICAL CONTROLS

Operating a programmable controller	55
Interfacing of computers	65
	120

ROBOTICS

Installing robots	43
Setting up work cells	23
Maintaining a robot	25
	91

CURRICULUM CONTENT

CURRICULUM CONTENT

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CURRICULUM CONTENT DESIGN

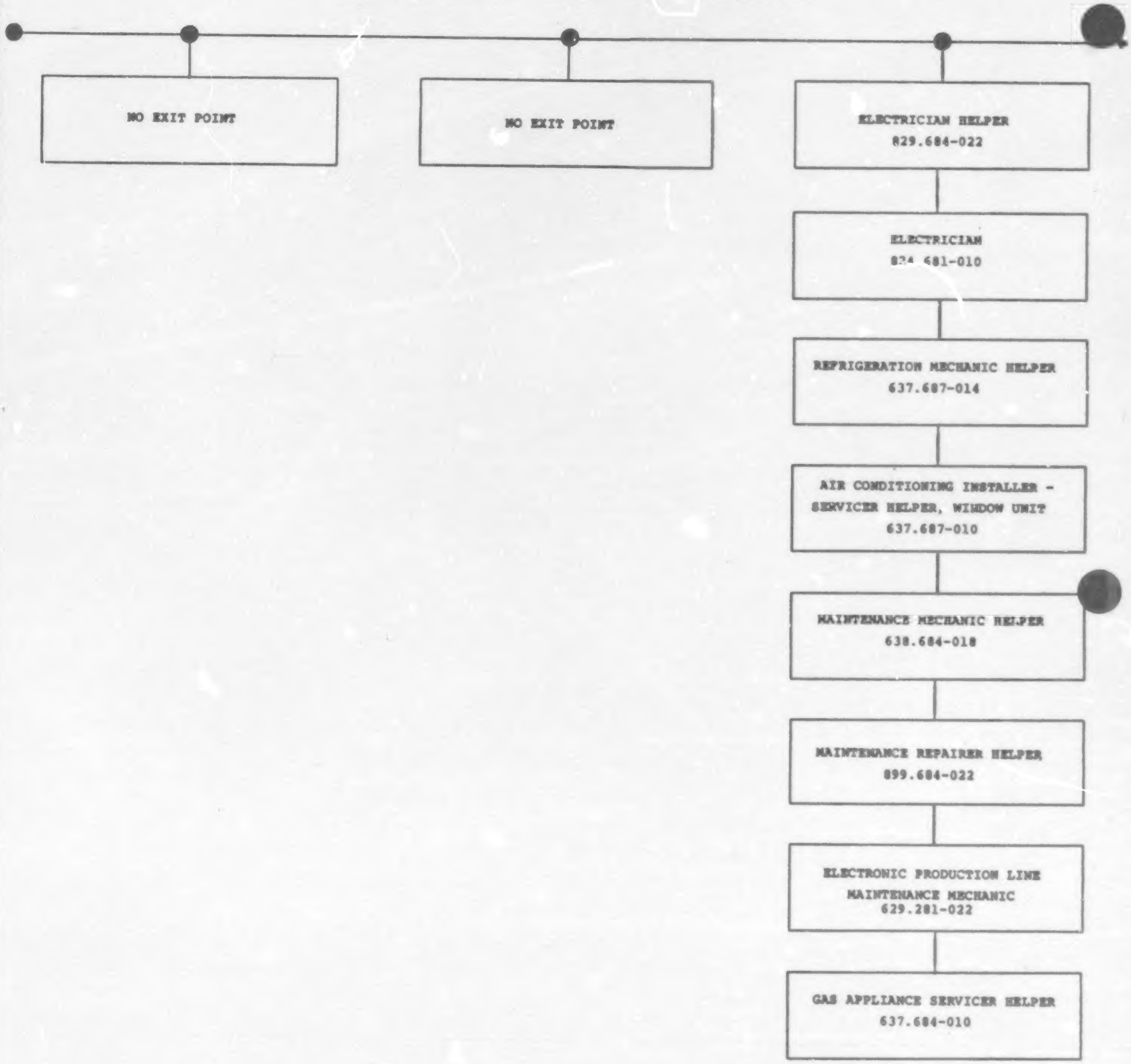
The Electromechanical Technology program is designed as a two year course. Fundamental skills and competencies (core curriculum) are emphasized during the first year, while a concentration of the more specialized skills and competencies occurs during the second year. The core curriculum serves as a prerequisite to additional study in the Electromechanical Technology program.

The core curriculum focuses on intensive study of the fundamental skills and competencies in the areas of Electricity, Electronics, Mechanics, and Fluid Power. Attention is also focused on reinforcing and integrating applicable reading, math, problem solving and communication skills in the curriculum.

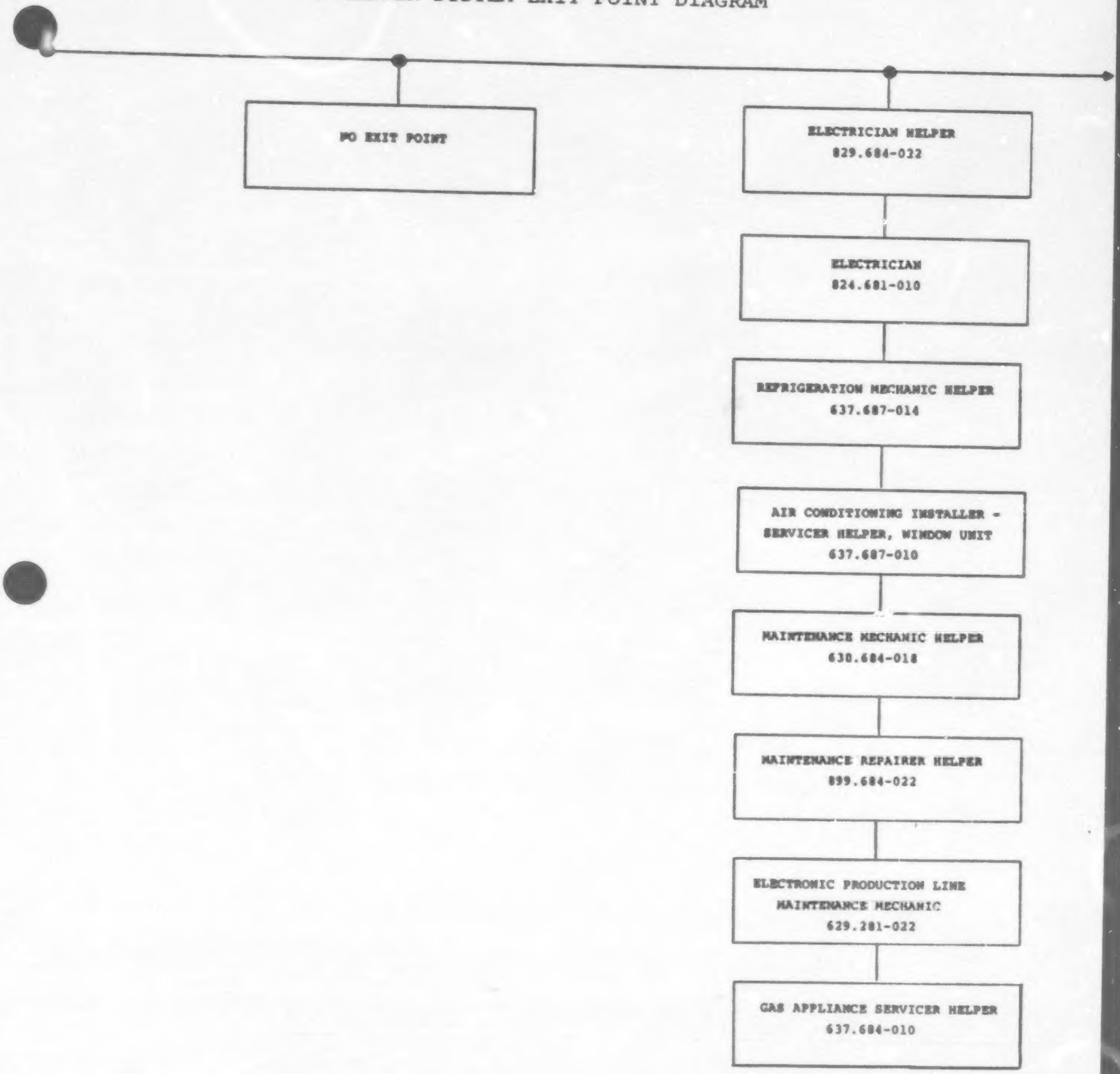
Students completing the core curriculum may elect to enter the workforce at the following occupational exit points:

Electrician Helper	(D.O.T. Code 829.684-022)
Electrician	(D.O.T. Code 824.681-010)
Refrigeration Mechanic Helper	(D.O.T. Code 637.687-014)
Air Conditioning Installer - Servicer Helper, Window Unit	(D.O.T. Code 637.687-010)
Maintenance Mechanic Helper	(D.O.T. Code 638.684-018)
Maintenance Repairer Helper	(D.O.T. Code 899.684-022)
Electronic Production Line Maintenance Mechanic	(D.O.T. Code 629.281-022)
Gas Appliance Servicer Helper	(D.O.T. Code 637.684-010)

QUARTER SYSTEM EXIT POINT DIAGRAM


NO EXIT POINT
NO EXIT POINT
ELECTRICIAN HELPER
829.684-022
ELECTRICIAN
824.681-010
REFRIGERATION MECHANIC HELPER
637.687-014
AIR CONDITIONING INSTALLER -
SERVICER HELPER, WINDOW UNIT
637.687-010
MAINTENANCE MECHANIC HELPER
638.684-018
MAINTENANCE REPAIRER HELPER
899.684-022
ELECTRONIC PRODUCTION LINE
MAINTENANCE MECHANIC
629.281-022
GAS APPLIANCE SERVICER HELPER
637.684-010

SEMESTER SYSTEM EXIT POINT DIAGRAM

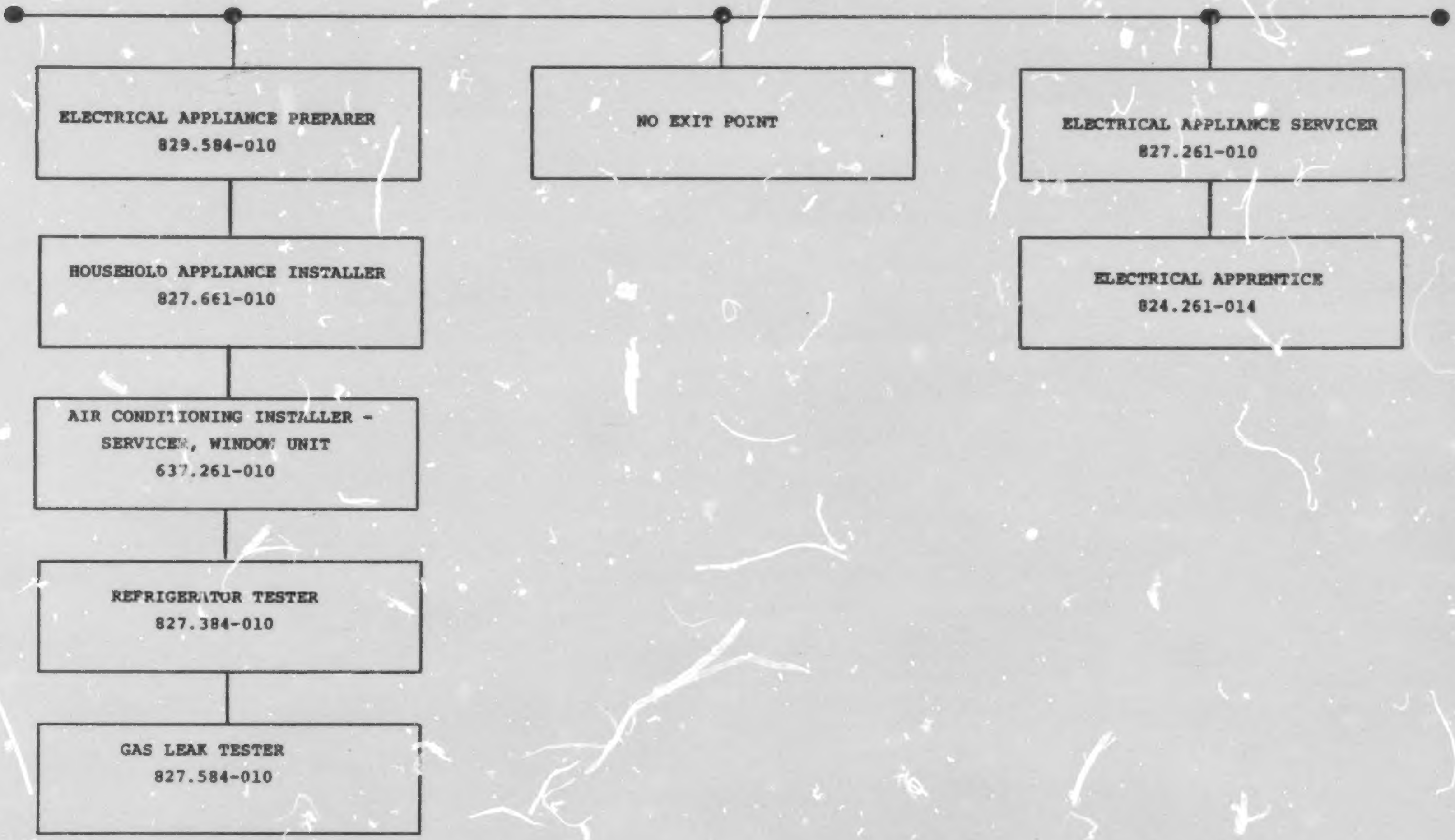

NO EXIT POINT
ELECTRICIAN HELPER
829.684-022
ELECTRICIAN
824.681-010
REFRIGERATION MECHANIC HELPER
637.687-014
AIR CONDITIONING INSTALLER -
SERVICER HELPER, WINDOW UNIT
637.687-010
MAINTENANCE MECHANIC HELPER
638.684-018
MAINTENANCE REPAIRER HELPER
899.684-022
ELECTRONIC PRODUCTION LINE
MAINTENANCE MECHANIC
629.281-022
GAS APPLIANCE SERVICER HELPER
637.684-010

Students desiring the more specialized skills and competencies may elect to continue in the Electromechanical Technology program during the second year. In contrast to the core curriculum, the second year is designed to provide students an opportunity to investigate and study optional courses in advanced occupational areas. Optional areas of study include Residential Electrical Wiring; Refrigeration; Major Appliances; Industrial Electricity; Hydraulics and Pneumatics; Computer Technology; Numerical Control; and Robotics. Attention is also directed toward reinforcing and integrating applicable reading, math, problem solving and communication skills in the curriculum. Because the information is extensive and requires considerable class and laboratory instructional time, students could not be expected to cover all the optional areas taught. A student could complete as many as three optional areas.

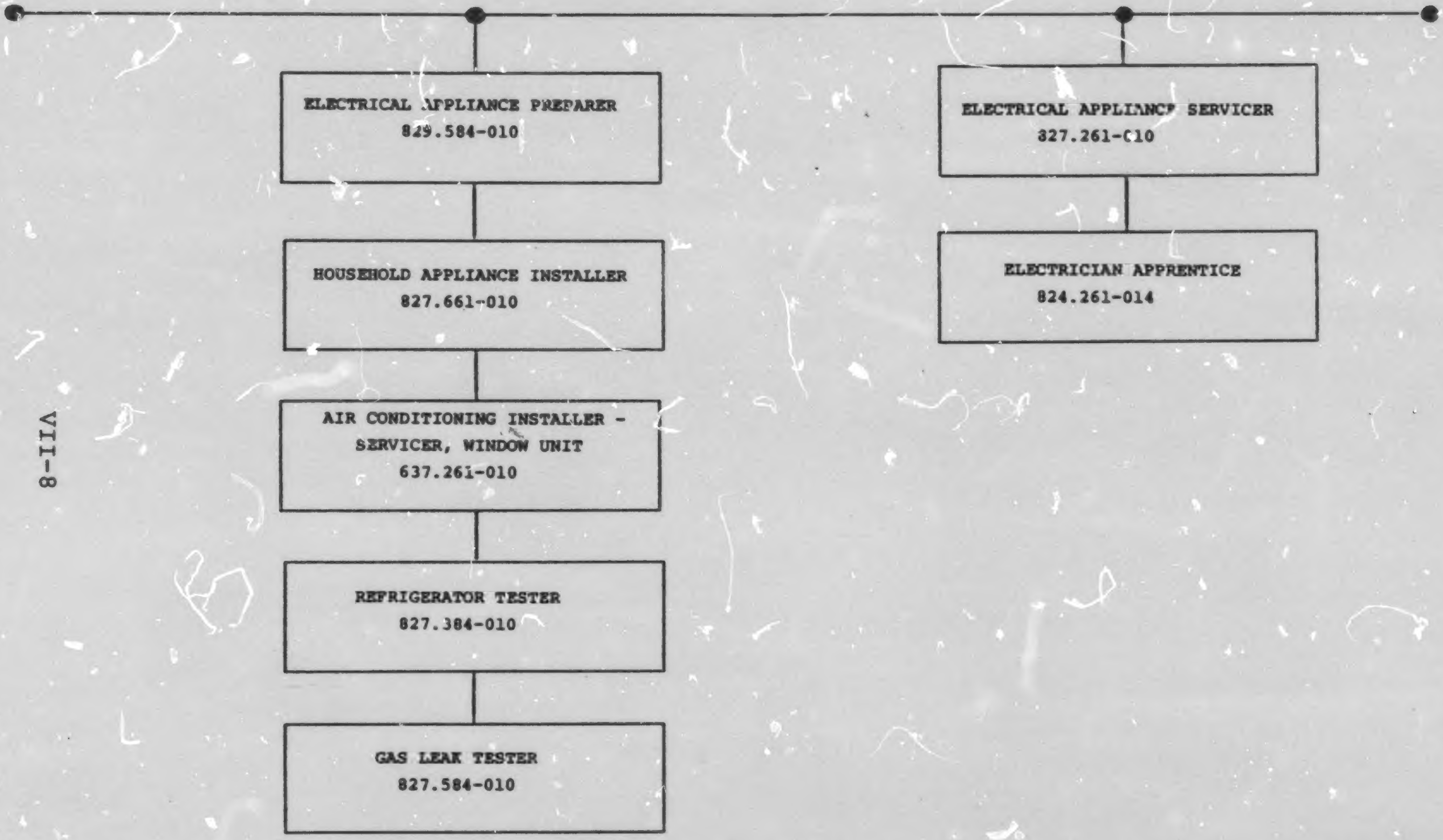
Occupational exit points which can be achieved during or at the conclusion of the second year include:

Electrical Appliance Preparer	(D.O.T. Code 829.584-010)
Household Appliance Installer	(D.O.T. Code 827.661-010)
Electrical Appliance Servicer	(D.O.T. Code 827.261-010)
Electrician Apprentice	(D.O.T. Code 824.261-014)
Air Conditioning Installer - Servicer, Window Unit	(D.O.T. Code 637.261-010)
Refrigerator Tester	(D.O.T. Code 827.384-010)
Gas Leak Tester	(D.O.T. Code 827.584-010)

QUARTER SYSTEM EXIT POINT DIAGRAM

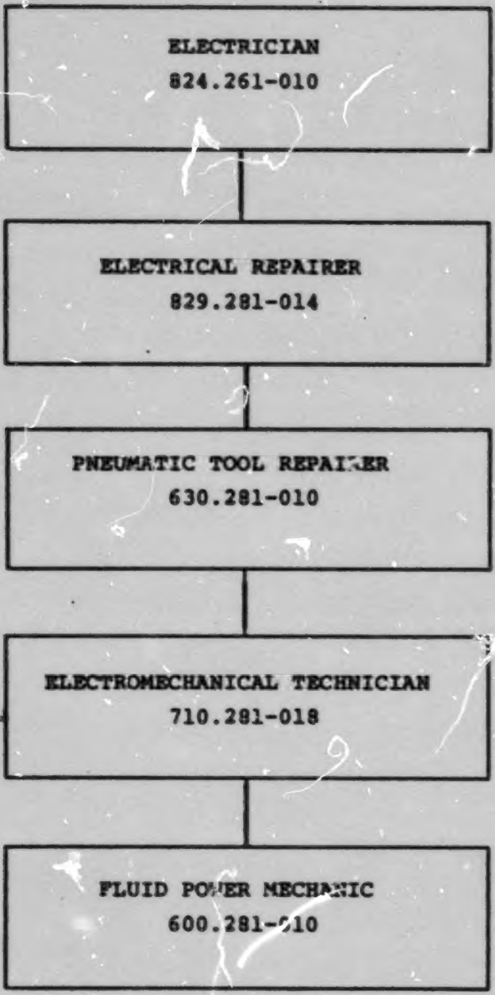

ELECTRICAL APPLIANCE PREPARER 829.584-010
HOUSEHOLD APPLIANCE INSTALLER 827.661-010
AIR CONDITIONING INSTALLER - SERVICER, WINDOW UNIT 637.261-010
REFRIGERATOR TESTER 827.384-010
GAS LEAK TESTER 827.584-010
NO EXIT POINT
ELECTRICAL APPLIANCE SERVICER 827.261-010
ELECTRICAL APPRENTICE 824.261-014

SEMESTER SYSTEM EXIT POINT DIAGRAM


ELECTRICAL APPLIANCE PREPARER
829.584-010
HOUSEHOLD APPLIANCE INSTALLER
827.661-010
AIR CONDITIONING INSTALLER - SERVICER, WINDOW UNIT
637.261-010
REFRIGERATOR TESTER
827.384-010
GAS LEAK TESTER
827.584-010
ELECTRICAL APPLIANCE SERVICER
827.261-010
ELECTRICIAN APPRENTICE
824.261-014

Beyond the two year program, with appropriate instruction, students could acquire additional areas of specialization. With additional competencies, they may pursue the following occupational exit points at the postsecondary level or in the workforce.

Electrician	(D.O.T. Code 824.261-010)
Electrical Repairer	(D.O.T. Code 829.281-014)
Pneumatic Tool Repairer	(D.O.T. Code 630.281-010)
Electromechanical Technician	(D.O.T. Code 710.281-018)
Fluid Power Mechanic	(D.O.T. Code 600.281-010)


ELECTRICIAN
824.261-010
ELECTRICAL REPAIRER
829.281-014
PNEUMATIC TOOL REPAIRER
630.281-010
ELECTROMECHANICAL TECHNICIAN
710.281-018
FLUID POWER MECHANIC
600.281-010

COURSE OUTLINE

On the following pages, a suggested course outline is presented for the Electromechanical Technology program. The course outline is a suggested method for structuring tasks into a logical teaching plan.

The core curriculum is designed to cover either three quarters or two semesters. A rigid course outline is presented for both alternatives. The optional area tasks are sequenced in a logical teaching order. Instructors will find it necessary to obtain student interests, needs and ambitions in a selected optional areas so that an instructional plan unique to each student can be developed.

SUGGESTED COURSE OUTLINE STRUCTURE FOR ELECTROMECHANICAL TECHNOLOGY

(Alternative 1)

Quarter I

Task		Hours
	Electricity/Electronics	
	Duty A: Electricity/Electronics Fundamentals	
EE-01	Observing electrical safety precautions	4
EE-02	Identifying and using hand tools	3
EE-03	Understanding the nature of matter	4
EE-04	Identifying sources of electricity	5
EE-05	Identifying circuit fundamentals	14
EE-06	Performing soldering and circuit fabrication	4
EE-07	Understanding the fundamentals of resistance	18
EE-08	Measuring voltage	9
EE-09	Measuring current	7
EE-10	Calculating power in circuits	8
EE-11	Identifying conductors and insulators	3
		79
	Duty B: Understanding Circuits	
EE-12	Making calculations using Ohm's Law	8
EE-13	Analyzing a series circuit	7
EE-14	Analyzing a parallel circuit	7
EE-15	Analyzing series-parallel circuits	11
		33
	Quarter I Total Hours	112

QUARTER II

Task		Hours
	Duty C: Understanding Motors/Generators	
EE-16	Applying fundamentals of magnetism	4
EE-17	Demonstrating a knowledge of motors	6
EE-18	Demonstrating a knowledge of generation	3
EE-19	Using alternating current principles	6
		20
	Duty D: Understanding RCL Circuits	
EE-20	Demonstrating a knowledge of inductance	4
EE-21	Demonstrating inductive reactance	4
EE-22	Demonstrating a knowledge of capacitance	4
EE-23	Computing RC time constants	3
EE-24	Calculating capacitive reactance	6
EE-25	Analyzing RCL series circuits	5
EE-26	Analyzing RCL parallel circuits	5
		31
	Duty E: Understanding Electronic Devices	
EE-27	Analyzing the PN junction	6
EE-28	Analyzing special semiconductor diodes	24
EE-29	Using the oscilloscope	4
EE-30	Analyzing rectifiers	8
EE-31	Identifying and analyzing filters	10
		52
	Quarter II Total Hours	102

Quarter III

Task		Hours
	Mechanics	
	Duty F: Calculating Mechanical Advantage	
M-01	Performing scientific calculations	18
M-02	Calculating the mechanical advantage of the lever	5
M-04	Calculating the mechanical advantage of the wheel and axle	6
M-06	Calculating the mechanical advantage of the inclined plane and wedge	8
M-08	Transmitting and calculating the force and motion with the screw thread	5
M-10	Calculating the mechanical advantage of the pulley system	6
		48
	Duty G: Using Mechanical Advantages	
M-07	Using the wedge	2
M-09	Using the screw	2
M-03	Using the lever	2
M-05	Using the wheel and axle	4
		10
	Fluid Power	
	Duty H: Fundamentals of Hydraulics/Pneumatics	
FP-01	Identifying safety precautions when working on hydraulic/pneumatic systems	2
FP-02	Defining hydraulics and pneumatics	2
FP-03	Explaining the fundamentals of hydraulics and pneumatics	8
FP-04	Identifying fluid power symbols	4
FP-05	Reading hydraulic and pneumatic schematic diagrams	3
FP-06	Recognizing hydraulic system basic components	8
FP-07	Recognizing pneumatic system basic components	8
		35

Employability Skills

Duty C: Employment Skills

Task		Hours
ES-01	Discussing and demonstrating how to get a job	10
ES-02	Discussing and demonstrating how to keep a job	10
		20
	Quarter III Total Hours	113

SUGGESTED COURSE OUTLINE STRUCTURE FOR ELECTROMECHANICAL TECHNOLOGY

(Alternative 2)

Semester I

Task		Hours
	Electricity/Electronics	
	Duty A: Electricity/Electronics Fundamentals	
EE-01	Observing electrical safety precautions	4
EE-02	Identifying and using hand tools	3
EE-03	Understanding the nature of matter	4
EE-04	Identifying sources of electricity	5
EE-05	Identifying circuit fundamentals	14
EE-06	Performing soldering and circuit fabrication	4
EE-07	Understanding the fundamentals of resistance	18
EE-08	Measuring voltage	9
EE-09	Measuring current	7
EE-10	Calculating power in circuits	8
EE-11	Identifying conductors and insulators	3
		79
	Duty B: Understanding Circuits	
EE-12	Making calculations using Ohm's Law	8
EE-13	Analyzing a series circuit	7
EE-14	Analyzing a parallel circuit	7
EE-15	Analyzing series-parallel circuits	11
		33
	Duty C: Understanding Motors/Generators	
EE-16	Applying fundamentals of magnetism	4
EE-17	Demonstrating a knowledge of motors	6
EE-18	Demonstrating a knowledge of generation	3
EE-19	Using alternating current principles	6
		19
	Duty D: Understanding RCL Circuits	
EE-20	Demonstrating knowledge of inductance	4
EE-21	Demonstrating inductive reactance	4
EE-22	Demonstrating a knowledge of capacitance	4
EE-23	Computing RC time constants	3
EE-24	Calculating capacitive reactance	6
EE-25	Analyzing RCL series circuits	5
EE-26	Analyzing RCL parallel circuits	5
		31
	Semester I Total Hours	162

Semester II

Duty E: Understanding Electronic Devices

Task		Hours
EE-27	Analyzing the PN junction	6
EE-28	Analyzing special semiconductor diodes	24
EE-29	Using the oscilloscope	4
EE-30	Analyzing rectifiers	8
EE-31	Identifying and analyzing filters	10
		52

Mechanics

Duty F: Calculating Mechanical Advantage

Task		Hours
M-01	Performing scientific calculations	18
M-02	Calculating the mechanical advantage of the lever	5
M-04	Calculating the mechanical advantage of the wheel and axle	6
M-06	Calculating the mechanical advantage of the inclined plane and wedge	8
M-08	Transmitting and calculating force and motion with the screw thread	5
M-10	Calculating the mechanical advantage of the pulley system	6
		48

Duty G: Using Mechanical Advantages

Task		Hours
M-07	Using the wedge	2
M-09	Using the screw	2
M-03	Using the lever	2
M-05	Using the wheel and axle	4
		10

Fluid Power

Duty H: Fundamentals of Hydraulics/Pneumatics

Task		Hours
FP-01	Identifying safety precautions when working on hydraulic/pneumatic systems	2
FP-02	Defining hydraulics and pneumatics	2
FP-03	Explaining the fundamentals of hydraulics and pneumatics	8
FP-04	Identifying fluid power symbols	4
FP-05	Reading hydraulic and pneumatic schematic diagrams	3
FP-06	Recognizing hydraulic system basic components	8
FP-07	Recognizing pneumatic system basic components	8
		35

Semester II

Employability Skills

Duty C: Employment Skills

ES-01	Discussing and demonstrating how to get a job	10
ES-02	Discussing and demonstrating how to keep a job	10
		20
	Semester II Total Hours	165

SECOND YEAR

RESIDENTIAL ELECTRICAL WIRING
(optional)

Task	Duty A: Residential Electrical Wiring Fundamentals	Hours
RW-01	Demonstrating a knowledge of the residential electrical wiring occupation	4
RW-02	Identifying electrical safety terms and practices	6
RW-03	Identifying and using electrical wiring specialty tools	6
RW-04	Using the National Electrical Code manual	8
RW-05	Identifying conductors, cables and cords	4
RW-06	Reading blueprints and rules	4
RW-07	Identifying and drawing electrical symbols used in residential wiring	12
RW-08	Identifying boxes and devices used in electrical wiring	4
		48
	Duty B: Ground Outlets (115v - 230v)	
RW-11	Designing and installing lighting circuits	10
RW-12	Designing and installing a three-way switch	10
RW-13	Installing a 115v appliance outlet	6
RW-14	Installing a convenience outlet	10
RW-15	Installing a split switched receptacle	10
RW-16	Installing a one-button and a two-button door bell circuit	10
RW-17	Installing 230v circuits and outlets	18
		74
	Duty C: Service Entrance	
RW-09	Installing load circuits	4
RW-10	Identifying and installing overcurrent protection devices	4
RW-18	Installing a temporary service entrance	16
RW-19	Installing a service entrance	4
		24
	Residential Electrical Wiring Total Hours	146

SECOND YEAR

REFRIGERATION
(optional)

Task	Duty A: Refrigeration Fundamentals	Hours
RF-01	Identifying career opportunities in refrigeration	4
RF-02	Identifying safe working conditions	3
RF-03	Demonstrating knowledge of basic refrigeration concepts	4
RF-04	Demonstrating a knowledge of the basic refrigeration cycle	8
RF-05	Identifying and using refrigeration tools	4
RF-06	Tapping, threading and replacing threads	12
RF-07	Identifying types of pipe and tube fittings used in refrigeration systems	4
		39
	Duty B: Tubing and Piping	
RF-08	Performing basic copper tubing operations	5
RF-09	Swaging, cleaning, fluxing and soft soldering copper tubing	5
RF-10	Silver brazing refrigeration piping	2
		12
	Duty C: Refrigerants	
RF-11	Handling, transforming, weighing and measuring refrigerants	2
RF-12	Installing and using access valves	6
RF-13	Maintaining refrigeration manifold gauges	2
RF-14	Installing and using refrigeration manifold gauges	5
RF-15	Evacuating a refrigeration system	12
RF-16	Installing refrigeration accessories	10
RF-17	Testing for leaks	2
RF-18	Charging a refrigeration system	6
		45
	Duty D: Troubleshooting	
RF-19	Troubleshooting refrigerator compressors	6
RF-20	Troubleshooting condensers	8
RF-21	Troubleshooting evaporators	8
RF-22	Troubleshooting automatic expansion valves	4
RF-23	Troubleshooting capillary tubes	4
RF-24	Troubleshooting thermostatic expansion valves	6
RF-25	Troubleshooting the refrigeration system	10
		46

Task	Duty E: Window Air Conditioning	Hours
RF-26	Installing a window air conditioning unit	6
RF-27	Performing pre-season start-up maintenance on window air conditioning units	4
RF-28	Troubleshooting compressor burnout in window air conditioners	8
RF-29	Evacuating and charging window air conditioners	8
RF-30	Troubleshooting fans and fan motors	4
RF-31	Troubleshooting mechanical problems in a window air conditioning refrigeration cycle	6
RF-32	Troubleshooting a window air conditioner electrical system	6
		42
	Duty F: Refrigerators and Freezers	
RF-33	Identifying and describing the function of refrigeration components	6
RF-34	Evacuating and charging domestic refrigerator and freezer systems	6
RF-35	Testing and replacing defective refrigeration cycle components	10
RF-36	Troubleshooting refrigerator/freezer compressor burnout	8
RF-37	Testing and repairing/replacing the refrigerator and/or freezer fans and fan motors	4
RF-38	Diagnosing problems in refrigerators and freezers	10
		4[illegible]
	Refrigeration Total Hours	228

SECOND YEAR

MAJOR APPLIANCES
(optional)

Task	Duty A: Installing Electric Appliances	Hours
MA-02	Installing and wiring an electric clothes dryer	8
MA-04	Installing, plumbing and wiring a clothes washer	10
MA-10	Installing, wiring and plumbing and electric water heater	8
MA-13	Installing and wiring a trash compactor	6
MA-15	Installing and wiring a microwave oven	8
MA-17	Installing and plumbing a dishwasher	20
MA-24	Installing and wiring an electric range, surface unit or wall oven	16
MA-28	Installing and wiring a cook top and vent	8
MA-30	Identifying and describing the function of the refrigeration components	10
MA-31	Installing and wiring a refrigerator and/or freezer	8
		102
	Duty B: Troubleshooting Electric Appliances	
MA-01	Developing a troubleshooting plan for a major appliance	10
MA-03	Troubleshooting and servicing electric dryer mechanical/electrical systems	12
MA-05	Troubleshooting and replacing the clothes washer water level control and door switches	12
MA-06	Troubleshooting and replacing the clothes washer timer and solenoids	15
MA-07	Troubleshooting and replacing the clothes washer motor and relay	16
MA-08	Troubleshooting and replacing the clothes washer drain pump	15
MA-09	Troubleshooting and replacing/repairing the clothes washer clutch and transmission	16
MA-11	Troubleshooting and replacing electric water heater elements	12
MA-12	Troubleshooting and replacing electric water heater thermostats	12
MA-14	Troubleshooting a trash compactor	12
MA-16	Troubleshooting and repairing microwave ovens	12
MA-18	Troubleshooting and replacing dishwasher water level control and door switches	10

Task	Duty B: Troubleshooting Electric Appliances (continued)	Hours
MA-19	Troubleshooting and replacing the dishwasher timer and soldnoids	15
MA-20	Troubleshooting and replacing the dishwasher motor and relay	10
MA-21	Troubleshooting and replacing or repairing the dishwasher drain pump	10
MA-22	Troubleshooting and replacing the dishwasher heating element and thermostat	10
MA-23	Troubleshooting and replacing the dishwwasher automatic dispenser	10
MA-25	Troubleshooting and replacing surface unit and oven heating elements	10
MA-26	Troubleshooting and replacing surface unit and oven temperature control switches and thermostats	12
MA-27	Troubleshooting and replacing the electric oven timer	12
MA-29	Troubleshooting a ceramic or conventional cook top	12
MA-32	Troubleshooting and replacing refrigeration components	25
MA-33	Evacuating and charging domestic refrigerator and freezer systems	15
MA-34	Troubleshooting and replacing electrical components of a refrigerator and/or freezer	15
		310
	Duty C: Installing Gas Appliances	
MA-35	Installing and plumbing a gas clothes dryer	20
MA-38	Installing and plumbing a gas water heater	20
HA-42	Installing and plumbing a gas range or a wall oven and surface unit	20
MA-47	Installing a gas orifice	12
		72
	Duty D: Troubleshooting Gas Appliances	
MA-36	Troubleshooting and servicing gas clothes dryer mechanical/electrical systems	12
MA-37	Troubleshooting, replacing and adjusting dryer gas controls	12
MA-39	Troubleshooting and replacing gas water heater relief valve	12
MA-40	Troubleshooting, replacing and adjusting water heater gas control	12

Task	Duty D: Troubleshooting Gas Appliances (continued)	Hours
MA-41	Troubleshooting and replacing gas water heater thermostat	12
MA-43	Troubleshooting and replacing gas range control	12
MA-44	Troubleshooting and replacing gas oven	12
MA-46	Troubleshooting gas lines and connections for leaks	5
MA-48	Adjusting the pilot light	12
MA-49	Adjusting the gas burner	10
		123
	Major Appliances Total Hours	607

SECOND YEAR

INDUSTRIAL ELECTRICITY
(optional)

Task	Duty A: Fundamentals	Hours
IE-01	Identifying hazardous wiring locations	6
IE-02	Locating service entrance equipment and writing specifications	10
		16
	Duty B: Selecting and Installing Conduit	
IE-03	Calculating and selecting service conduits	10
IE-04	Installing service conduits	15
IE-05	Installing outlet, junction box and conduit	10
IE-06	Installing conduit under a concrete slab	10
		45
	Duty C: Selecting and Installing Branch Circuits	
IE-07	Calculating branch circuit conductors and overcurrent protection	10
IE-08	Determining sizes and types of feeders and overcurrent protection devices	10
IE-09	Selecting and installing a 480v208-210 three phase four wire service	10
IE-10	Installing branch circuits and controls for air conditioning and heating	10
		40
	Duty D: Selecting and Installing Lighting Circuits	
IE-11	Installing branch circuits and controls for lighting	10
IE-12	Calculating the 120 and 277 volt lighting load	10
IE-13	Selecting and installing a 277 volt fluorescent light	8
		28

Task	Duty E: Installing Wiring for Large Equipment	Hours
IE-14	Hooking up a three phase transformer	10
IE-15	Making calculations for electric motors	10
IE-16	Identifying motor leads	8
IE-17	Operating a capacitor start motor	8
IE-18	Operating a three phase induction motor	8
		44
	Industrial Electricity Total Hours	173

SECOND YEAR

HYDRAULICS AND PNEUMATICS
(optional)

Task	Duty A: Fundamentals of Hydraulics and Pneumatics	Hours
HP-09	Identifying basic hydraulic/pneumatic circuits	6
HP-05	Identifying and describing the properties of different hydraulic fluids	7
HP-01	Selecting reservoirs used in hydraulic systems	4
HP-06	Preventing hydraulic and pneumatic system contamination	6
		23
	Duty B: Installing and Servicing Hydraulic/Pneumatic Systems and Equipment	
HP-02	Selecting and installing lines, fittings and couplers used in hydraulic/pneumatic systems	5
HP-03	Selecting and installing seals used in hydraulic/pneumatic systems	5
HP-04	Selecting and installing pumps in hydraulic systems	6
HP-07	Selecting and installing cylinders used in hydraulic/pneumatic systems	14
HP-08	Selecting and installing valves on hydraulic/pneumatic systems	7
HP-10	Selecting and installing compressors used in pneumatic systems	5
HP-11	Selecting and installing motors used in hydraulic/pneumatic systems	9
HP-12	Selecting and installing accessories used on a pneumatic system	5
HP-13	Selecting and installing accessories used on a hydraulic system	5
		55
	Duty C: Maintenance of Hydraulic/Pneumatic Systems	
HP-14	Planning the maintenance of a hydraulic system	5
HP-15	Planning the maintenance of a pneumatic system	5
		10
	Hydraulics and Pneumatics Total Hours	88

SECOND YEAR

COMPUTER TECHNOLOGY
(optional)

Task	Duty A: Understanding Computers	Hours
CO-01	Understanding computer arithmetic	15
CO-02	Understanding microprocessor hardware	25
CO-03	Understanding the functions of a computer	35
		75
	Duty B: Using Computers	
CO-04	Using the microcomputer	18
		18
	Duty C: Analyzing Computer Problems	
CO-05	Analyzing microcomputer circuits	18
		18
	Computer Technology Total Hours	111

SECOND YEAR

NUMERICAL CONTROLS
(optional)

Task	Duty A: Operating Programmable Controllers	Hours
NC-01	Operating programmable controllers	20
NC-02	Operating solid state logic motor controls	35
		55
	Duty B: Interfacing of Computers	
NC-03	Understanding instrumentation for programmable controllers	20
NC-04	Interfacing a microcomputer with peripherals	20
NC-05	Using a microcomputer as a controller	25
		65
	Numerical Controls Total Hours	120

SECOND YEAR

ROBOTICS
(optional)

Task	Duty A: Installing Robots	Hours
R-01	Comparing robotic systems	13
R-02	Installing robots	30
		43
	Duty B: Setting Up Work Cells	
R-03	Designing a work cell	13
R-04	Scheduling robot work assignments	10
		23
	Duty C: Maintaining a Robot	
R-05	Repairing and maintaining robotic systems	25
		25
	Robotics Total Hours	91

UNIT GUIDES

Unit guide sheets, the core of a curriculum guide, serve as instructional resources which aid the instructor in planning the instruction and/or performance related to tasks or unit competencies.

Specific unit guide components include:

Task or Unit Competency: The smallest division of work in which a measurable output occurs.

Performance Statement: What students are expected to accomplish.

Instructional Materials: Suggested materials used to assist in the presentation of instructional activities.

Class/Lab Hours: The estimated minimum time for completing the instructional activities and the evaluation. Instructors must use their judgment in determining the percentage of total time spent in the class and in the lab.

Evaluation of Performance: Includes criterion referenced measures and suggested testing activities and resources pertinent to accomplishing the task or unit competency.

TASK OR UNIT COMPETENCY

EE-01 Observing electrical safety precautions

PERFORMANCE STATEMENT

Observe electrical safety precautions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical shock
b. First aid
c. Conductors
d. Insulators
e. Electrical circuit
    1. Source
    2. Path
    3. Load
f. Overloaded circuit
g. Octopus outlet
h. Fuse
i. Circuit breaker
j. Electrical fires
k. Fire extinguishers
l. Safety color coding
m. Preventing electrical accidents
n. Grounding
o. Shop safety rules

Provide Demonstration On:

a. Providing first aid to electrical shock victims
b. Extinguishing electrical fires

Provide Practical Application On:

Developing a safety checklist

INSTRUCTIONAL MATERIALS

Textbooks:

a. Matt, Electricity and Basic Electronics
b. MAVCC, Basic Electronics 1
c. MAVCC, Basic Electronics 2

Students Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Blankets
b. Gauze
c. Fire extinguishers
d. Insulator to move victim (ex. dry stick)

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of standard shop materials, equipment and practices, the student will identify with 100% accuracy, safe and unsafe practices and precautionary measures to be taken to prevent hazardous electrical situations.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of good electrical safety practices. Students should be retested on incorrect items.

b. Students should be given a performance test to assess their ability to apply good safety practices.

c. Students should be given a performance test to assess their ability to care for shock victims.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Interpret instructions
c. Interpret graphic information
Problem Solving Skills
a. Recognize cause and effect relationships
b. Locate information in reference materials
c. Estimate outcomes
d. Draw conclusions
e. Interpret non-graphic instructions
f. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

EE-02 Identifying and using hand tools

PERFORMANCE STATEMENT

Identify and use hand tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Names and function of basic hand tools
b. Names of parts of hand tools
c. Factors to consider when selecting hand tools
d. Maintenance procedures for hand tools
e. Hand tool safety

Provide Demonstration On:

Cleaning, maintaining and storing tools

Provide Practical Application On:

Using all hand tools

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. MAVCC, Basic Electronics 2
c. Stanley Tool Guide

Tools and Equipment:

a. Screwdrivers
    1. Flat head
    2. Phillips head
    3. Torex, Robertson
b. Hammers and mallets
    1. Carpenters
    2. Machinists
    3. Soft face
c. Wrenches
    1. Adjustable end
    2. Open end
    3. Box end
    4. Pipe
    5. Socket
    6. Ratchet
    7. Torque
    8. Hex
d. Pliers
    1. Slip joint
    2. Locking
    3. Linesman
    4. Diagonal wire cutters
    5. Lone nose
    6. Needle nose
e. Hacksaws
f. Punches and chisels
    1. Center punch
    2. Drift punch
    3. Aligning punch
    4. Gasket punch
g. Drills
h. Files
i. Taps and dies
j. Wire gauge

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a pictorial diagram of several basic hand tools, the student will identify and give the function of each with 90% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the names and function of several basic hand tools.

b. Students should be given a performance test to assess their ability to use several basic hand tools properly and safely.

c. Students should be given a performance test to assess their ability to clean, lubricate, and adjust wire strippers and pliers.

d. Use resources provided in the Instructional Materials section on the previous page.

Math Skills
a. Measurement
b. Whole number manipulation
Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Problem Solving Skills
a. Recognize sequence of events, cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Interprets graphic data
e. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

EE-3 Understanding the nature of matter

PERFORMANCE STATEMENT

Understand the nature of matter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Atoms
    1. Nucleus
    2. Protons
    3. Neutrons
    4. Electrons
    5. Orbits
    6. Free valence electrons
    7. Flow of electrons
    8. Random drift theory
b. Law of electrical charges
c. Production of electricity
    1. Static
    2. Chemical
    3. Generators
d. Conductors
e. Insulators
f. Electromotive force
g. Current
h. Resistance

(continued on next page)

Provide Demonstration On:

a. Composition of an atom
b. Calculating electromotive force
c. Using Ohm's Law

Provide Practical Application On:

The generation of electricity

INSTRUCTIONAL MATERIALS

Textbooks:

a. Matt, Electricity and Basic Electronics
b. MAVCC, Basic Electronics 1
c. MAVCC, Basic Electronics 2
d. Olivo and Olivo, Fundamentals of Applied Physics
e. Singer and Forster, Basic Mathematics for Electricity and Electronics

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 0

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

i. Electricity circuit
j. Volts
k. Amperage
l. Ohms
m. Watts
n. Electrical safety

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of terms associated with the nature of matter, the student will give their correct definitions with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the nature of matter.

b. Students should be given a written test to assess their knowledge on calculating electromotive force.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Grob, Basic Electronics

f. Malvino, Electronic Principles

g. Miller and Culpepper, Experiences with Electronics

Math Skills
a. Ratios, proportions, and percents
b. Fractions and decimal usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversions
Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Problem Solving Skills
a. Recognize sequence of events, cause and effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

EE-04 Identifying sources of electricity

PERFORMANCE STATEMENT

Identify sources of electricity.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The major sources of electricity
    1. Chemical
    2. Magnetic
    3. Light
    4. Heat
    5. Pressure
    6. Friction
b. Battery cell
c. Generator
d. Alternator
e. Photoelectric effect
f. Thermocouple
g. Piezoelectricity effect
h. Magnet
i. Static electricity
j. Hydrometer
k. Specific gravity

Provide Demonstration On:

Producing electricity using chemical, magnetic, light, heat, pressure, and friction sources

Provide Practical Application On:

a. Using electricity to do work
b. Testing specific gravity with a hydrometer
c. Using a galvanometer to measure small amounts of current

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2

Tools and Equipment:

a. Battery
b. Magnet
c. Coil of wires
d. Galvanometer
e. Light bulbs (same voltage as battery)
f. Phonograph crystal in holder with needle
g. Photocell

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of several different electrical producing devices, the student will identify which of the six major sources it belongs to with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the six major sources of electricity.

b. Students should be given a performance test to assess their ability to measure small amounts of current with a galvanometer.

c. Students should be given a performance test to assess their ability to test the specific gravity of a battery using a hydrometer.

d. Use resources provided in the Instructional Materials section in the previous page.

e. Badrkhan and Larky, Electronics: Principles and Applications

f. Malvino, Electronic Principles

g. Mims, Getting Started in Electronics

Math Skills
a. Measurement
b. Whole number manipulation
Reading Skills
a. Interpret instructions
b. Locate information in reference materials
Problem Solving Skills
a. Locate information in reference materials
b. Draw conclusions
c. Interpret non-graphic information
d. Make predictions, generalizations, and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

EE-05 Identifying circuit fundamentals

PERFORMANCE STATEMENT

Identify circuit fundamentals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Basic components of a circuit
  1. Path
  2. Load
  3. Source
- b. Basic circuit elements and symbols
  1. Battery
  2. Generator
  3. Transformer
  4. Resistor
  5. Lamp
  6. Speaker
  7. Switch open
  8. Switch closed
  9. Relay open
  10. Relay closed
  11. Conductor
  12. Conductors connected
  13. Conductors not connected
  14. Capacitors
  15. Diodes
  16. Transistors
  17. Ground

Provide Demonstration On:

Constructing a circuit containing the three basic components

Provide Practical Application On:

Construction of circuits from a schematic

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Grob, Basic Electronics
- b. Matt, Electricity and Basic Electronics
- c. MAVCC, Basic Electronics 1
- d. MAVCC, Basic Electronics 2
- e. Mims, Getting Started in Electronics

Tools and Equipment:

- a. Wire with snap connectors
- b. Switches
- c. Battery
- d. Light

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a schematic of a simple circuit, the student will construct the circuit and identify current flow and circuit components with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of standard circuit loads, sources and paths.

b. Students should be given a performance test to assess their ability to construct a circuit from a schematic.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Heathkit, DC Electronics

e. Malvino, Electronic Principles

f. Miller and Culpepper, Experiences with Electronics

g. Singer and Forster, Basic Mathematics for Electricity and Electronics

Math Skills
a. Whole number manipulation
b. Metric conversions
c. Ratios, proportions, percents
d. Fraction and decimal usage and conversions
Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-06 Performing soldering and circuit fabrication

PERFORMANCE STATEMENT

Perform soldering and circuit fabrication.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Solder
  - 1. Rosin core
  - 2. Acid core
- b. Soldering tools
  - 1. Iron
  - 2. Pencil
  - 3. Gun
  - 4. Heat sink
  - 5. Solder sucker
  - 6. Wire strippers
  - 7. Pliers
- c. Oxides
- d. Tinning
- e. Soldering procedure
- f. Soldering connections
- g. Splice
- h. Schematics
- i. Circuit components

Provide Demonstration On:

- a. Proper soldering techniques
- b. Soldering connections

Provide Practical Application On:

- a. Tinning
- b. The use of the soldering pencil, gun, and iron

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Caprio, Appliance Repair
- b. Matt, Electricity and Basic Electronics
- c. MAVCC, Basic Electronics 1
- d. MAVCC, Basic Electronics 2
- e. Miller and Culpepper, Experiences with Electronics
- f. Mims, Getting Started in Electronics

Tools and Equipment:

- a. Solder
  - 1. Acid core
  - 2. Rosin core
- b. Soldering tools
  - 1. iron
  - 2. Pencil
  - 3. Gun
  - 4. Heat sink
  - 5. Solder sucker
  - 6. Wire strippers
  - 7. Pliers
- c. Wire (22 or 18 guage)
- d. Circuit board
- e. Resistors and other circuit components

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the necessary equipment and supplies, the student will solder and fabricate a simple electrical circuit with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the names and functions of soldering tools.

b. Students should be given a performance test to assess their ability to solder making proper connections.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Heathkit, DC Electronics

e. Grob, Basic Electronics

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret instructions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Estimate outcomes, with or without units or measurements
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-07 Understanding the fundamentals of resistance

PERFORMANCE STATEMENT

Understand the fundamentals of resistance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Resistance
b. Resistors
    1. Fixes
    2. Adjustable
c. Resistor color code
d. Ohm
e. Ohmmeter
f. Wattage
g. Tolerance
h. Metric prefixes
i. Types
    1. Carbon
    2. Wire wound
    3. Film and ceramic
    4. Variable
    5. Rheostat/potentiometer
j. Symbols
k. Scientific notation

Provide Demonstration On:

a. Measuring resistance with an ohmmeter
b. Determining the resistance values of resistors by using the color codes

Provide Practical Application On:

a. Testing a resistor to see if it is in tolerance
b. Determining the value of unknown resistors by using the color code
c. Testing the solenoid coil resistance of range to see if it is in tolerance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Caprio, Appliance Repair
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Miller and Culpepper, Experiences with Electronics
f. Mims, Getting Started in Electronics
g. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Resistors
b. Color code chart
c. Ohmmeter
d. Solenoid coil of a range

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 12

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an assortment of resistors, the student will identify the type and value of each resistor by using the color code chart and the ohmmeter with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use an ohmmeter properly.

b. Students should be given a written test to assess their knowledge of the color code chart.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Grob, Basic Electronics

f. Malvino, Electronic Principles

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversion
c. Ratios, proportions, and percents
d. Metric conversions
e. Algebra

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Recognize relevance of data

Performance Objective (CRM)

Suggested Testing Activities And Resources

e. Interpret graphic data
f. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-08 Measuring voltage with a voltmeter

PERFORMANCE STATEMENT

Measure voltage with a voltmeter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Voltage
b. Volt
c. Voltage drop
d. Voltmeter
e. Kirchoff's Law
f. Current flow
g. Metric prefixes
h. Voltage sources
    1. Batteries
    2. Generators/alternators
    3. Electronic power supplies
i. Electromotive force (EMF)
j. Ohm's Law
k. Alternating current (AC)
l. Direct current (DC)
m. How to use a voltmeter

Provide Demonstration On:

Measuring voltage using a voltmeter

Provide Practical Application On:

Measuring outlet voltage of a major appliance using a voltmeter

INSTRUCTIONAL MATERIALS

Textbooks:

a. Caprio, Appliance Repair
b. Grob, Basic Electronics
c. Matt, Electricity and Basic Electronics
d. MAVCC, Basic Electronics 1
e. MAVCC, Basic Electronics 2
f. Miller and Culpepper, Experiences with Electronics
g. Mims, Getting Started in Electronics
h. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Voltmeter
b. Batteries (DC)
c. Electrical outlet (AC)
d. Major appliance

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a voltmeter and a complete circuit containing three resistors of various values, the student will measure the voltage drops and source voltage with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a perfromance test to assess their ability to use a voltmeter.

b. Students should be given a written test to assess their knowledge of Kirchoff's Law.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Prinicples

Math Skills
a. Whole number manipulation
b. Decimals and fraction usage and conversions
c. Metric conversions
d. Algebra

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Estimate outcomes, with or without units or measurements
d. Recognize relevance of data
e. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-09 Measuring current with an ammeter

PERFORMANCE STATEMENT

Measure current with an ammeter.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Current
b. Columb
c. Direct current
d. Alternating current
e. Series circuit
f. Parallel circuit
g. Amperes
h. Ammeter
i. Metric prefixes
j. Ohm's Law
k. Scientific notation

Provide Demonstration On:

a. Using an ammeter to measure direct current
b. Converting amperes to milliamps and microamps

Provide Practi[illegible] Application On:

Measuring direct current in a live circuit using a ammeter

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Miller and Culpepper, Experiences with Electronics
f. Mims, Getting Started in Electronics
g. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. Ammeter, AC and DC
c. DC variable power supply

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an ammeter and live DC and AC circuits, the student will measure and compare two points of a circuit, at two different power levels, with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of converting amps to milliamps and microamps.

b. Students should be given a performance test to assess their ability to measure current using an ammeter.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Principles

Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversions
c. Metric conversions
d. Algebra

Reading Skills
a. Interpret instructions
b. Recognize relevance of data
c. Recognize appropriate reference resources
d. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Recognize relevance of data

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-10 Calculating power in circuits

PERFORMANCE STATEMENT

Calculate power in circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical power
b. Watt
c. Kilowatt
d. Kilowatthours
e. Fuse
f. Circuit breaker
g. Ohm's Law
h. Power formula
i. Fractions
j. Square roots
k. Wattmeter

Provide Demonstration On:

a. Calculating power using Ohm's Law and the power formula
b. Using fuses or circuit breakers in a circuit

Provide Practical Application On:

a. Determining the power needed in a resistive circuit
b. Using a wattmeter

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Miller and Culpepper, Experiences with Electronics
f. Mims, Getting Started in Electronics
g. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. DC variable power supply
c. Wattmeter

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a simple DC Circuit, the student will calculate watts of power with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of computing power using Ohm's Law and the power formula.

b. Students should be given a performance test to assess their ability to measure the power of a DC circuit using a wattmeter.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Principles

Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversions
c. Metric conversions
d. Algebra
e. Squares and square roots

Reading Skills
a. Interpret instructions
b. Recognize relevance of data
c. Recognize appropriate reference resources
d. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Recognize relevance of data

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-11 Identifying conductors and insulators

PERFORMANCE STATEMENT

Identify conductors and insulators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conductors
b. Semiconductors
c. Insulators
d. Resistance
e. Dielectric
f. Atoms
    1. Electrons
    2. Free valence electrons
    3. Random drift theory
    4. Orbits
g. Wire size and gauge numbers
h. Applications of conductors
i. Applications of insulators
j. Applications of semiconductors

Provide Demonstration On:

a. Conductor resistance and voltage drop
b. Measuring wire using a wire gauge

Provide Practical Application On:

The common uses of conductors, insulators, and semiconductors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Miller and Culpepper, Experiences with Electronics
f. Mims, Getting Started in Electronics

Tools and Equipment:

a. Conductors
b. Insulators
c. Semiconductors
d. Wire gauge
e. Basic electricity/electronics trainer
f. VOM
g. Variable voltage supply

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of several low, medium and high resistance materials, the student will classify each into insulators, conductors, and semiconductors with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of conductors, semiconductors, and insulators.

b. Students should be given a performance test to assess their ability to measure wire using a wire gauge.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Principles

f. Singer and Forster, Basic Mathematics for Electricity and Electronics

Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversion
c. Metric conversions
d. Algebra
e. Measurement
Reading Skills
a. Follow directions
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements

Performance Objective (CRM)

Suggested Testing Activities And Resources

e. Draw conclusions
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-12 Making calculations using Ohm's Law

PERFORMANCE STATEMENT

Make calculations using Ohm's Law.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Ohm's Law
b. Volt (electromotive force)
c. Amper (current)
d. Watt
e. Ohm (resistance)
f. Fractions
g. Metric system
h. Circular expression of Ohm's Law
i. Exponents

Provide Demonstration On:

a. Calculating voltage current and resistance using Ohm's Law
b. Solving algebraic equations using exponents

Provide Practical Application On:

Experimentally verifying Ohm's Law calculations

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics
f. Olivo and Olivo, Fundamentals of Applied Physics
g. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. VOM
c. Variable voltage DC supply

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the Ohm's Law formula and a set of problems involving fractions, decimals, positive and negative numbers, and exponents, the student will calculate the missing values with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of Ohm's Law.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret instructions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversions
c. Metric conversions
d. Algebra
Problem Solving Skills
a. Recongize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with ot without units or measurements
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

EE-13 Analyzing a series circuit

PERFORMANCE STATEMENT

Analyze a series circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Series circuit
b. Short circuit
c. Fuse
d. Circuit
    1. Open
    2. Closed
e. Circuit breaker
f. Voltage drop
g. Applied voltage
h. IR drop
i. Current
j. Resistance
k. Power
l. VOM
m. Electronic symbols
n. Circuit analysis
o. Current flow
p. Ampere meter

Provide Demonstration On:

a. Measuring voltage and voltage drops in a series circuit
b. Measuring total current and resistance in a series circuit

Provide Practical Application On:

Using a VOM on series circuits

INSTRUCTIONAL MATERIALS

Testbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. VOM
c. Variable voltage DC supply
d. DC ampere meter

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a VOM and a simple series circuit, the student will measure and calculate electrical values with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of analyzing series circuits.

b. Students should be given a performance test to assess their ability to use a VOM to analyze a series circuit.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvino, Electronic Principles

e. Badrkhan and Larky, Electronics: Principles and Applications

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret instructions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-14 Analyzing a parallel circuit

PERFORMANCE STATEMENT

Analyze a parallel circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parallel circuit
b. Circuit analysis
c. Parameter
d. Variable
e. Reciprocal
f. Shorts
g. Voltage
h. Current
i. Resistance
j. Symbols
k. Ohm's Law
l. VOM
m. Node

Provide Demonstration On:

a. Measuring voltage, current, and resistance in a parallel circuit
b. Computing power in a parallel circuit

Provide Practical Application On:

Using a VOM on parallel circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics
f. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electiricty/electronics trainer
b. VOM
c. Variable voltage DC supply
d. AC and DC ampere meter

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a VOM and a simple parallel circuit, the student will measure and calculate electrical values with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of analyzing parallel circuits.

b. Students should be given a performance test to assess their ability to use a VOM and a DC ampere meter to analyze a parallel circuit.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Principles

Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret instructions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-15 Analyzing series-parallel circuits

PERFORMANCE STATEMENT

Analyze series-parallel circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Series-parallel circuit
b. Node
c. Circuit reduction
d. Ground
    1. Earth
    2. Chassis
e. Voltage divider
f. Symbols
g. Kirchoff's Law
h. Current flow
i. Ohm's Law
j. Voltage
k. Current
l. Resistance
m. Shorts
n. Circuit analysis
o. VOM

Provide Demonstration On:

Measuring and calculating quantities in a series-parallel circuit

Provide Practical Application On:

a. The construction of a voltage divider
b. The use of a VOM to analyze series parallel circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics
f. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. VOM
c. Variable voltage DC supply

ESTIMATED CLASS HOURS 7

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a VOM and a series-parallel circuit, the student will measure and calculate electrical values with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of analyzing series-parallel circuits.

b. Students should be given a performance test to assess their ability to use a VOM to analyze series-parallel circuits.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Principles

Math Skills
a. Whole number manipulation
b. Decimals and fractions usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret instructions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships

b. Recognize appropriate reference sources

c. Locate information in reference materials

d. Estimate outcomes, with or without units or measurements

e. Interpret non-graphic information

f. Recognize relevance of data

g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences

b. Organize information

c. Interpret aural communications

d. Compose oral directions and qeustions

e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-16 Applying fundamentals of magnetism

PERFORMANCE STATEMENT

Apply fundamentals of magnetism.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Magnetism
b. Magnet
    1. Natural
    2. Artificial
    3. Electromagnet
c. Induction
    1. Magnetic induction
    2. Electromagnet induction
d. Magnetic field
e. Poles
f. Magnet permeability
g. Magnetic properties
h. Left hand rule
i. Law of electrical charges
j. Applications of magnetism
    1. Generators
    2. Relays
    3. Speakers
    4. Motors
    5. Meters
    6. Cranes

Provide Demonstration On:

a. Constructing an electromagnet
b. The existence of magnetic lines

Provide Practical Application On:

The function of solenoids in washing machines

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Basic electricity/electronics trainer
b. Variable voltage DC supply
c. VOM
d. Compass
e. Permanent magnet
f. Iron fillings
g. Solenoids from washing machines

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 1

Performance Objective (CRM)

Given an assortment of magnetic and electromagnetic devices, the student will identify each by name, and explain the application of each device with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written test to assess their knowledge of magnets and magnetic fundamentals.

b. Use resources provided in the Instructional Materials section on the previous page.

c. Malvino, Electronic Principles

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

EE-17 Demonstrating a knowledge of motors

PERFORMANCE STATEMENT

Demonstrate a knowledge of motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motors
    1. AC
    2. DC
    3. Induction
    4. Split-phase
    5. Capacitor start
    6. Shaded-pole
    7. Universal
    8. Relay-start
b. Horsepower
c. Torque
d. Footpounds
e. Prony brake
f. Armature
g. Field
h. Commutator
i. Stator
j. Rotor
k. Brushes

(continued on next page)

Provide Demonstration On:

a. The basic parts of various motors
b. A capacitor and its component parts
c. AC and DC motors

Provide Practical Application On:

a. The uses of various types of motors
b. Changing brushes in a universal motor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Caprio, Appliance Repair
b. Grob, Basic Electronics
c. Matt, Electricity and Basic Electronics
d. MAVCC, Basic Electronics 1
e. MAVCC, Basic Electronics 2

Tools and Equipment:

The following types of motors:

1. AC
2. DC
3. Induction
4. Split-phase
5. Capacitor start
6. Shaded pole
7. Universal
8. Relay-start

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 1

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

l. Magnetic field
m. Conductor field
n. Power formula
o. Watts
p. Capacitor
q. Governor
r. Windings
s. Voltage drops
t. Centrifugal switch
u. Current draw relay
v. Tapped field windings

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram of a motor containing input voltage and amperage, the student will identify the motor and all major parts of the motor, and calculate motor power and efficiency with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the various types, components, and functions of motors.

b. Students should be given a written test to assess their knowledge on calculating motor power.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Miller and Culpepper, Experiences with Electronics

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents
Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or wihtout units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

EE-18 Demonstrating a knowledge of generation

PERFORMANCE STATEMENT

Demonstrate a knowledge of generation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Generator
b. Electromagnetic induction
c. Induced voltage
d. Stator
e. Rotor
f. Field windings
g. Commutator
h. Yoke and base
i. Armature and slip rings
j. Phase
    1. Angle
    2. Difference
k. Brushes
l. Magnetic flux
m. Electron flow
n. AC
o. DC
p. Three phase
q. Voltage phasor (vector)

Provide Demonstration On:

a. The use of the left hand generator ruls
b. AC cycle values at 0, 90, 180, and 270 degrees

Provide Practical Application On:

The construction of AC and DC generators

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2

Tools and Equipment:

a. Horseshoe magnet
b. Galvanometer
c. 12 feet hook up wire
d. Slip rings

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 1

Performance Objective (CRM)

Given a list of electrical generation terms and components, the student will identify and given the correct definition for each item with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written test to assess their knowledge of standard electrical generation terms and components.

b. The students should be given a performance test to assess their ability to construct a simple generator.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimte outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-19 Using alternating current principles

PERFORMANCE STATEMENT

Use alternating current principles.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of alternating current
b. Cycle
c. Alternation
d. Amplitude
e. Frequency
f. Period
g. Hertz
h. Peak amplitude
i. Wave length
j. Peak to peak
k. Degrees and radians conversions (2 pi radians equals 360 degrees)
l. Sine wave
    1. Sine function
    2. Root-mean-square (RMS)
m. Current
n. Voltage
o. Amperage
p. Phase
q. Oscilloscope
r. Signal generator

Provide Demonstration On:

a. Converting degrees, radians, and cycles
b. Sine wave relationships
c. Calculating RMS

Provide Practical Application On:

Using the oscilloscope to measure AC values

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electro-Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Singer and Forster, Basic Mathematics for Electricity and Electronics

Tools and Equipment:

a. Oscilloscope
b. Signal generator

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram of a sine wave, the student will label all of its basic parts with 90% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of sine wave relationships.

b. Students should be given a written test to assess their knowledge of using sine wave conversions.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Malvino, Electronic Principles

f. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction use and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, percents

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

EE-20 Demonstrating a knowledge of inductance

PERFORMANCE STATEMENT

Demonstrate a knowledge of inductance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of inductance
b. Inductor
c. Henry
d. Self-inductance
e. Mutual-inductance
f. Coupling coefficient
g. Transformer
h. Lenz's Law
i. Inductor factors
j. Inductors in circuits
    1. Series
    2. Parallel
k. Voltage
l. Current
m. Power
n. Reciprocal formulas
o. Metric prefixes

Provide Demonstration On:

a. Computing inductance in parallel circuits
b. Calculating transformer ratios
c. Testing how different core materials affect inductance in an AC circuit

Provide Practical Application On:

The use of transformers to step up or down voltage by induction

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Eelctronics 1
d. MAVCC, Basic Electronics 2
e. Singer and Forster, Basic Mathematics for Electricity and Electronics

Tools and Equipment:

a. Two induction coils
b. Variable AC power supply
c. Lamp
d. Copper, aluminum, soft iron, and laminated iron bars
e. Wire

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given several diagrams containing inductors in series and parallel, the student will calculate the total inductances of the circuits with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of inductors placed in series and parallel.

b. Students should be given a written test to assess their knowledge of transformer ratios.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvino, Electronic Principles

e. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimte outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

EE-21 Determining inductive reactance

PERFORMANCE STATEMENT

Determine inductive reactance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of inductive reactance
b. Resistance
c. Reactance
d. Power
    1. Reactive
    2. Apparent
    3. Power factor
e. Ohm's Law
f. Hertz
g. Radians
h. Frequency
i. Current
j. Voltage
k. RL Circuit
l. Impedence
m. Symbols and formulas
n. Square root and squares
o. Henry
p. Resistors
q. Time constants

Provide Demonstration On:

a. Computing inductive reactance
b. Computing applied voltage and impedance of RL circuits

Provide Practical Application On:

The use of inductors in an AC circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Singer and Forster, Basic Mathematics for Electricity and Electronics

Tools and Equipment:

a. Filler choke 2h or larger
b. 75 ohm, 1 watt resistor
c. DC and AC milliammeters
d. Multimeter
e. AC and DC variable power supply

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list contining problems on inductive reactance and impedance, the student will calculate the correct answers with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written test to assess their knowledge of calculating inductive reactance and impedence of a circuit.

b. The sutdents should be given a performance test to assess their ability to set up a circuit containing an inductor from a schematic.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvion, Electronic Principles

e. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Algebra
d. Ratios, proportions, and percents

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-22 Demonstrating a knowledge of capacitance

PERFORMANCE STATEMENT

Demonstrate a knowledge of capacitance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitance
   1. Functions of capacitance
   2. Formulas for capacitance
b. Capacitor
   1. Fixed
   2. Variable
   3. Capacitor construction
   4. Types of capacitors
c. Dielectric
d. Farad
e. Dielectric constant
f. Coulmb
g. Color code
h. Charging and discharging
i. Metric prefixes
j. Symbols concerning capacitance
k. Ohmmeter
l. Direct current (DC)
m. Alternating current (AC)
n. Polarization

Provide Demonstration On:

a. Computing capacitance in series and parallel circuits
b. The effects of AC and DC on capacitors
c. How to make a capacitor
d. Charging and discharging capacitors

Provide Practical Application On:

a. Testing capacitors with an ohmmeter
b. Using capacitors to filter pulsating voltage in power supplys

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics
f. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Ohmmeter
b. Three capacitors (large, medium, small e.g. less than 0.1 microfarad)
c. One shorted capacitor
d. One open capacitor
e. One leaky capacitor
f. Power supply

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given several diagrams containing capacitors in series and parallel, the student will calculate the total capacitance of the circuit with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of capacitors placed in series and parallel.

b. Students should be given a performance test to assess their ability to test capacitors using an ohmmeter.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Applications

e. Miller and Culpepper, Experiences with Electronics

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-23 Computing RC time constants

PERFORMANCE STATEMENT

Compute RC time constants.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Capacitance
b. Resistance
c. RC circuits
d. Time constant
e. Exponential function
f. Integrating circuit
g. Charging and discharging an RC circuit
h. Wave shapes during charging and discharging
i. Formulas for computing time constants
j. Ohms
k. Farads
l. Metric prefixes
m. Series and parallel

Provide Demonstration On:

Computing RC time constants

Provide Practical Application On:

Diagraming, constructing, calculating parameters and measuring values in series and parallel RC circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics
f. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. DC power supply, 0-100 volts
b. Two 2.2 M-ohm resistors
c. Two 1 microfarad capacitors (at least 100 volts)
d. Neon bulb

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given several diagrams containing RC circuits, the student will determine the constants with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written exam to assess their knowledge of RC circuits.

b. The students should be given a performance test to assess their ability to construct RC circuits from a schematic.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Application

e. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-24 Calculating capacitive reactance

PERFORMANCE STATEMENT

Calculate capacitive reactance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Formula for computing capacitive reactance
b. Resistance
c. Reactance
d. Impedance
e. Power
f. Computing applied voltage, impedance and power
g. Reactive power
h. Apparent power
i. Power factor
j. Phase angle
k. Symbols associated with capacitive reactance
l. Relationship between current and voltage
m. Figure of merit (Q)
n. Ohm's Law for capacitive reactance
o. Low pass filters
p. High pass filters

Provide Demonstration On:

a. Computing capacitive reactance
b. Determining impedance in RC circuit

Provide Practical Application On:

The use of capacitors as filters

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Eelctronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Mims, Getting Started in Electronics
f. Singer and Forster, Basic Mathematics for Electricity and Electronics

Student Manuals:

Heathkit, DC Electronics

Tools and Equipment:

a. Variable power supply
b. Sine wave signal generator
c. AC voltmeter
d. .001 microfarad capacitor
e. .039 microfarad capacitor
f. .1 microfarad capacitor
g. .47 microfarad capacitor
h. 4.7 K ohm 1/2 watt resistor
i. 47 K ohm 1/2 watt resistor

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of diagrams for AC series and parallel capacitive circuits, the student will calculate the capacitive reactance with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of capacitive reactance and impedance.

b. Use resources provided in the Instructional Materials section on the previous page.

c. Badrkhan and Larky, Electronics: Principles and Applications

d. Miller and Culpepper, Experiences with Electronics

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

Reading Skills
a. Recongize main ideas, details, sequence of events and cause effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

EE-25 Analyzing RCL series circuits

PERFORMANCE STATEMENT

Analyze RCL series circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. RCL circuits
   1. Resistor
   2. Inductor
   3. Capacitor
b. Reactance
c. Impedance
d. Resonance
e. Band width
f. Relationship between current and voltage
g. Tuned series RCL cirucits
h. The Q of a series tuned circuit
i. Bandwidth

Provide Demonstration On:

a. Determining impedance, voltage and resonance in series circuits
b. Determining Q and bandwidth of a series circuit

Provide Practical Application On:

a. Construction of RCL series circuits
b. Reading a schematic

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Singer and Forster, Basic Mathematics for Electricity and Electronics

Tools and Equipment:

a. Audio generator
b. Oscilliscope
c. Multimeter
d. 1-microfarad capacitor
e. 1H inductor
f. 100-ohm resistor
g. Linear graph paper
h. Variable power supply

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of diagrams containing RCL series circuits, the student will calculate impedance voltage, resonance, Q, and bandwidth with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written test to assess their knowledge of RCL series circuits.

b. The students should be given a performance test to assess their ability to construct RCL series circuits from a schematic.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Application

e. Miller and Culpepper, Experience with Electronics

Reading Skills

a. Recognize main ideas, detaisl, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognzie appropriate reference resources
i. Locate information in reference materials

Math Skills

a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions and percents

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communication
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-26 Analyzing RCL parallel circuits

PERFORMANCE STATEMENT

Analyze RCL parallel circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. RCL circuits
    1. resistor
    2. Capacitor
    3. Inductor
b. Node
c. Resonance
d. Filter
e. Tank circuit
f. Current voltage relationship
g. Formulas
    1. Total current
    2. Impedance
    3. Resonance
    4. Band width
    5. Q
h. Tuned RCL circuits

Provide Demonstration On:

a. Determining impedance, voltage and resonance in parallel circuits
b. Determining Q and band width in parallel circuits

Provide Practical Application On:

a. Construction of RCL parallel circuits
b. Reading a schematic

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 1
d. MAVCC, Basic Electronics 2
e. Singer and Forster, Basic Mathematics for Electricity and Electronics

Tools and Equipment:

a. Audio frequency generator
b. Variable power supply
c. Multimeter
d. Ammeter, 0-150 microamps
e. .001 microfarad capacitor
f. 10 Kohms, 1 watt resistor
g. 10 millihenery inductor
h. Graph paper

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of diagrams containing RCL parallel circuits, the student will calculate impedance, voltage, resonance, Q and band width with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written test to assess their knowledge of RCL parallel circuits.

b. The students should be given a performance test to assess their ability to construct RCL parallel circuits from a schematic.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Badrkhan and Larky, Electronics: Principles and Application

e. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, percents, and proportions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-27 Analyzing the PN juction

PERFORMANCE STATEMENT

Analyze the PN junction.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. PN Junction
  1. N-electrons
  2. P-holes
b. Atoms
  1. Nucleus
  2. Proton
  3. Neutron
  4. Electron
  5. Valence
c. Insulator
d. Conductor
e. Semiconductor
f. Doping
g. Bias
  1. Forward
  2. Reverse
h. Peak inverse voltage
i. Breakdown
j. Manufacturing
k. Anode
l. Cathode
m. Silicon
n. Germanium

Provide Demonstration On:

a. Forward and reverse bias
b. The PN junction
c. Types of semi-conductor materials and devices

Provide Practical Application On:

a. Testing semiconductor diodes and ploting their characteristic curves
b. The use of semiconductor diodes in a full-wave rectifier

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 2
d. Mims, Getting Started in Electronics

Tools and Equipment:

a. Variable DC power supply
b. 1-220 ohm, 5 watt resistor
c. 1-silicon diode, (1N914 or equivalent)
d. 2-multimeters
e. Graph paper

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of terms associated with semiconductors and the PN junction, the student will give their correct definitions with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of semiconductors and the PN junction.

b. Students should be given a performance test to assess their ability to test semiconductor diodes.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvino, Electronic Principles

e. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Follow directions
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Decimal and fraction suage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Interpret non-graphic information
e. Recognize relevance of data
f. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-28 Analyzing special semiconductor diodes

PERFORMANCE STATEMENT

Analyze special semiconductor diodes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Semiconductors
b. Zener diode (reference or breakdown diode)
   1. Operating point
   2. Zener voltage
   3. Zener current
   4. Voltage regulator
   5. Reference element
c. Tunnel diode
   1. Negative resistance region
   2. Peak point
   3. Valley point
   4. Forward point
   5. Amplifiers
   6. Oscillators
   7. Switches
   8. Multivibrators

(continued on next page)

Provide Demonstration On:

a. Graphing the characteristic curve for a zener and tunnel diode
b. Constructing a zener diode voltage regulator
c. Constructing circuits from a schematic

Provide Practical Application On:

a. The use of zener diodes as a voltage regulator and reference element
b. The use of tunnel diodes in switches, amplifiers, oscillators, and multivibrators
c. The use of varactor diodes in automatic frequency controls and variable RC and LC filters
d. The use of LED's in electroluminescent displays and logic-level indicators
e. The use of photodiodes in light detection systems, high speed card and tape readers, and production line counting

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 2
d. Mims, Getting Started in Electronics

Tools and Equipment:

a. Variable power supply
b. 2-DC voltmeters
c. 1-DC milliameter
d. 1-1K ohm resistor, 1/2 watt
e. 1-10K ohm resistor, 1/2 watt
f. 1-1N4739 zener diode
g. Graph paper

ESTIMATED CLASS HOURS 12

ESTIMATED LAB HOURS 12

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On
(continued)

d. Varactor diode (varicaps or voltcaps)
    1. Barrier capacitance
    2. Automatic frequency control
    3. Variable RC and LC filters
e. Light-emitting diode (Led)
    1. Electroluminescent display
    2. Logic-level indicators
f. Photo diode
    1. Impute-light intensity
    2. Light detection system
    3. High speed card and tape readers
g. Forward bias
h. Reverse bias
i. Schematic symbols
j. Cathode
k. Anode
l. Current flow
m. Color code
n. P-N junction
o. Silicon
p. Germanium

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a written test on semiconductor diodes, the student will give the symbol, name, function, and application of the diodes, and lable the zener and tunnel characteristic curves with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the special semiconductor diodes.

b. Students should be given a performance test to assess their ability to construct circuits containing semiconductor diodes from a schematic

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvion, Electronic Principles

e. Miller and Culpepper, Experience with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalization and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Algebra
d. Ratios, proportions, and percents

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Organize data into graphics
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-29 Using the oscilloscope

PERFORMANCE STATEMENT

Use the oscilloscope

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Oscilloscope safety
b. Oscilloscope preliminary control settings and calabration
c. Oscilloscope hookup to circuit
d. Scale interpretation
e. Scale controls

Provide Demonstration On:

a. How to use the oscilloscope manual to set up vertical and horizontal controls
b. How to read the voltage, frequency, and period of an AC signal

Provide Practical Application On:

Measuring voltage, current, period, frequence, and time intervals

INSTRUCTIONAL MATERIALS

Textbooks:

a. Refer to oscilloscope owner's manual
b. Grob, Basic Electronics
c. Matt, Electricity and Basic Structure

Tools and Equipment:

a. Variable power supply
b. Oscilloscope
c. Sine wave generator

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an oscilloscope and necessary circuits, the student will measure and record the peak to peak amplitude, period, and frequence of signals within 10% of known values.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use an oscilloscope

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Ratios, proportions, and percents

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-30 Analyzing rectifiers

PERFORMANCE STATEMENT

Analyze rectifiers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rectifier circuit
b. Half-wave rectifier
c. Full-wave rectifier
    1. Formulas
    2. Conventional
    3. Bridge
d. Transformer
e. Voltage doubler
f. Ripple effect

Provide Demonstration On:

a. The construction of
    1. Half-wave rectifier circuits
    2. Conventional full-wave rectifier
    3. Bridge rectifier
    4. Voltage doubler circuit
b. Calculating DC voltage

Provide Practical Application On:

a. The use of rectifiers to change AC to DC
b. Construction of a rectifier from a schematic
c. Testing diodes in major appliances

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 2
d. Mims, Getting Started in Electronics

Tools and Equipment:

a. Auto transformer 0-130 V
b. Power transformer 110-220 Vt
c. 4 silicon diodes 1N914
d. 1-10k, 1W resistor
e. Multimeter
f. Oscilloscope
g. Graph paper

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the proper components, the student will construct a half-wave, full-wave, and voltage doubler circuit, and indicate current flow with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to construct rectifiers.

b. Students should be given a written test to assess their knowledge of calculating the average DC voltage of rectifiers.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvino, Electronic Principles

e. Miller and Culpepper, Experiences with Electronics

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

EE-31 Identifying and analyzing filters

PERFORMANCE STATEMENT

Identify and analyze filters.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Filters
   1. Purpose
   2. Capacitor
   3. PI-section
   4. L-section
b. Ripple
c. Bleeder resistor
d. Voltage regulation
e. Percent regulation
f. DC (direct current)
g. Ac (alternating current)
h. Wave shapes
i. Symbols associated with filters
j. Diodes
k. Transformers
l. Capacitors
m. Resistors
n. Current flow

Provide Demonstration On:

a. Basic filter configurations
b. Calculating ripple factors and percent regulation
c. Wave shapes using the oscilloscope

Provide Practical Application On:

a. Constructing and testing a capacitor filter circuit
b. Constructing and testing a PI-section filter circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Grob, Basic Electronics
b. Matt, Electricity and Basic Electronics
c. MAVCC, Basic Electronics 2
d. Singer and Forster, Basic Mathematics for Electricity and Electronics

Tools and Equipment:

a. Low power filament transformer (120 V primary)
b. 4-silicon diodes 1N914
c. 1-10K, 1/2 watt resistor, 1-1K1/2 watt resistor, 2-20 microfarad capacitors 25WVdc or greater
d. Multimeter
e. Oscilloscope
f. Graph paper
g. 1-270 ohm resistor
h. Variable power supply

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a written exam, the student will identify the three basic types of filter configurations, calculate ripple factors, and sketch voltage wave shapes with 80% accuracy.

Suggested Testing Activities And Resources

a. The students should be given a written test to assess their knowledge of filters.

b. The students should be given a performance test to assess their ability to construct and test the three basic filter configurations.

c. Use resources provided in the Instructional Materials section on the previous page.

d. Malvino, Electronic Principles

e. Miller and Culpepper, Experiences with Electronics

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Whole number manipulation
b. Decimal and fraction usage and conversions
c. Metric conversions
d. Algebra
e. Ratios, proportions, and percents

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Organize data into graphics
h. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

FP-01 Identifying safety precautions when working on hydraulic/pneumatic systems

PERFORMANCE STATEMENT

Identify safety precautions when working on hydraulic/pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety hazards
b. Safe practices

Provide Demonstration On:

a. Potential hazards
b. Safe practices in the lab

Provide Practical Application On:

Demonstrating safe practices in the lab

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Hydraulics
b. Parker/Hannifin, Fluid Power
c. Pippenger and Hicks, Industrial Hydraulics
d. Vickers, Industrial Hydraulic Manual

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

Hydraulic/pneumatic system trainer

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a tour of the hydraulics/pneumatics lab, the student will identify potential safety hazards with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of safety rules in the lab.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisions
d. Draw conclusions
e. Recognize relevance of data
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Draw conclusions
c. Interpret non-graphic information
d. Recognize relevance of data
e. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information

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TASK OR UNIT COMPETENCY

FP-02 Defining hydraulics and pneumatics

PERFORMANCE STATEMENT

Define hydraulics and pneumatics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Brief definition of hydraulics
b. Brief definition of pneumatics
c. Advantages and disadvantages of hydraulics and pneumatics

Provide Demonstration On:

Systems which utilize hydraulics and pneumatics

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Hydraulics
b. Parker/Hannifin, Fluid Power
c. Pippenger and Hicks, Industrial Hydraulics
d. Vicker's, Industrial Hydraulic Manual

A/Vs:

Parker/Hannifin, "Fluid Power"
(TR) (ST)

Student Manuals:

MAVCC, Hydraulics

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a hypothetical working environment, the student will list the advantages and disadvantages of hydraulic and pneumatic systems with 90% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their ability to explain briefly the definitions of hydraulics and pneumatics.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Recognize relevance of data
e. Recognize appropriate reference sources
f. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

FP-03 Explaining the principles of hydraulics and pneumatics

PERFORMANCE STATEMENT

Explain the principles of hydraulics and pneumatics.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Relation between
  - 1. Force
  - 2. Weight and mass
  - 3. Pressure
  - 4. Area
  - 5. Volume
  - 6. Speed
- b. Power and work
- c. Energy in hydraulic and pneumatic systems
  - 1. Potential energy
  - 2. Kinetic energy
    - a. Mechanical
    - b. Electrical
    - c. Heat
  - 3. Diffusion of energy
  - 4. Physical laws in hydraulic and pneumatic systems
    - 1. Pascal's Law
    - 2. Boyle's Law
    - 3. Charles' Law

(continued on next page)

Provide Demonstration On:

- a. Function of basic hydraulic/pneumatic system
- b. Disassembling, cleaning and reassembling a hydraulic/pneumatic jack

Provide Practical Application On:

- a. Using measurement instruments
- b. Reading measurement instruments
- c. Distinguishing between lifting and lowering a hydraulic/pneumatic jack

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Manufacturer's manual
- b. MAVCC, Hydraulics
- c. Parker/Hannifin, Fluid Power
- d. Pippenger and Hicks, Industrial Hydraulics
- e. Vickers, Industrial Hydraulic Manual

A/Vs:

- a. MAVCC, "Hydraulics" (TR)
- b. Parker/Hannifin, "Fluid Power (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

- a. Hydraulic/pneumatic jack
- b. Hand tools
- c. Hydraulic fluid
- d. Lint free rags

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 5

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

- 4. Ideal Gas Law
- 5. Bernoulli's principle
- 6. Mechanical advantage and efficiency

e. Properties of fluids in hydraulics
- 1. Separation of liquids and gasses
- 2. Viscosity and compressibility
- 3. Fluid flow in pipes
- 4. Density and specific gravity

f. Measurements
- 1. Units of measurement
- 2. Instruments of measure
  - a. Pressure
  - b. Flow rate
  - c. Temperature

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the basic scientific principles pertaining to the transmission of energy and power by a hydraulic and a pneumatic system, the student will explain the principles with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of energy types, Pascal's Law, Boyle's Law, Charles' Law, the Ideal Gas Law and Bernoulli's principle.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Draw conclusions
c. Recognize relevance of data
d. Recognize appropriate reference sources
e. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Squares and square roots
f. Apply formulas
g. Identify points on cartesian coordinates

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Interpret graphic data

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

FP-04 Identifying fluid power symbols

PERFORMANCE STATEMENT

Identify fluid power symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Symbols
b. Lines
    1. Working
    2. Pilot
    3. Drain
    4. Joining (connected)
    5. Crossing
c. Reservoir
d. Pump
e. Cylinder
f. Directional valve and operation
g. Check valve
h. Envelope

Provide Demonstration On:

Fluid power symbols

Provide Practical Application On:

Identifying symbols on a fulid power schematic

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Types of accessories
b. Hydraulic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a fluid power schematic, the student will identify all of the symbols with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of matching fluid power symbols to their definitions.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Interpret graphic data
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Recognize relevance of data
e. Organize data into graphics
f. Interpret graphic data
Communication Skills
a. Organize information

TASK OR UNIT COMPETENCY

FP-05 Reading hydraulic and pneumatic schematic diagrams

PERFORMANCE STATEMENT

Read hydraulic and pneumatic schematic diagrams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components and types of hydraulic and pneumatic systems
b. Terms used to describe hydraulic and pneumatic systems
c. Symbols used to depict components in hydraulic and pneumatic systems

Provide Demonstration On:

a. Symbols
b. Types of diagrams
   1. Pictorial
   2. Cutaway
   3. Schematic

Provide Practical Application On:

Identifying symbols on a hydraulic and a pneumatic diagram

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Hydraulics
b. Parker/Hannifin, Fluid Power
c. Pippenger and Hicks, Industrial Hydraulics
d. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

Types of hydraulic and pneumatic diagrams

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

Performance Objective (CRM)

Given hydraulic and pneumatic diagrams, the student will interpret the diagrams with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to distinguish among pictorials, cutaways and schematics.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Interpret graphic information
c. Recognize appropriate reference resources
d. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Organize data into graphics
c. Interpret graphic data
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Organize data into graphics
d. Interpret graphic data
Communication Skills
a. Organize information

TASK OR UNIT COMPETENCY

FP-06 Recognizing hydraulic system basic components

PERFORMANCE STATEMENT

Recognize hydraulic system basic components.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic components
    1. Reservoirs
    2. Lines, fittings, and couplers
    3. Fluids
    4. Filters
    5. Pumps
    6. Valves
    7. Cylinders
    8. Seals
    9. Motors
    10. Accessories
b. The description of each component
c. The purpose of each component

Provide Demonstration On:

The basic components of a hydraulic system

Provide Practical Application On:

Identifying basic components of a hydraulic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Hydraulics
b. Parker/Hannifin, Fluid Power
c. Pippenger and Hicks, Industrial Hydraulics
d. Vickers, Industrial Hydraulic Manual

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Hydraulic system trainer
b. Basic hydraulic components
c. Diagrams of hydraulic basic components

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given basic components of a hydraulic system, the student will identify each component by name with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to describe briefly each component.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Recognize appropriate reference resources
d. Locate information in reference materials

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Interpret non-graphic information

Communication Skills
a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

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TASK OR UNIT COMPETENCY

FP-07 Recognizing pneumatic system basic components

PERFORMANCE STATEMENT

Recognize pneumatic system basic components

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic components
   1. Lines, fittings and couplers
   2. Filters, regulators, lubricators, and air treatment devices
   3. Compressors
   4. Valves
   5. Cylinders
   6. Seals
   7. Motors
   8. Accessories

b. The description of each component by manufacturer

c. The purpose of each component

Provide Demonstration On:

The basic components of a pneumatic system

Provide Practical Application On:

Identifying basic components of a pneumatic system

INSTRUCTIONAL MATERIALS

Textbooks:

Parker/Hannifin, Industrial Pneumatic Technology

Tools and Equipment:

a. Pneumatic system trainer
b. Basic pneumatic components
c. Diagrams of pneumatic basic components

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given basic components of a pneumatic system, the student will identify each component by name with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to describe briefly each component.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Draw conclusions
b. Recognize appropriate reference resources
c. Locate information in reference materials
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Interpret non-graphic information
Communication Skills
a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

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TASK OR UNIT COMPETENCY

M-01 Performing scientific calculations

PERFORMANCE STATEMENT

Perform scientific calculations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Scientific notation
b. Engineering notation
c. Binary system
d. Law of exponents
e. Trigonometry functions
    1. Sine
    2. Cosine
    3. Tangent
f. Logarithm
g. Calculator
    1. Data keys
    2. Function keys
    3. Register

Provide Demonstration On:

a. The use of electronic calculators
b. Scientific and engineering notation
c. The use of trigonometric functions
d. Logarithms and using logarithm charts

Provide Practical Application On:

Using a calculator to perform scientific calculations

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Basic Electronics 1
b. MAVCC, Basic Electronics 2
c. Singer and Forster, Basic Mathematics for Electricity and Electronics
d. Texas Instruments, The Great International Math on Keys Book

Tools and Equipment:

a. Calculator
b. Logarithm chart
c. Trigonometric functions chart

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 2

Performance Objective (CRM)

Given a variety of scientific problems and an electronic claculator, the student will compute the correct solutions with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of trigonometric functions.

b. Students should be given a written test to assess their knowledge of scientific and engineering notation.

c. Students should be given a performance test to assess their ability to use an electronic calculator properly.

d. Use resources provided in the Instructional Materials section on the previous page.

e. Matt, Electricity and Basic Electronics

Math Skills

a. Scientific and engineering notation
b. Law of exponents
c. Logarithms
d. Trigonometry
    1. Sine
    2. Cosine
    3. Tangent
e. Ratios, proportions and percents
f. Fractions and decimal usage and conversions
g. Whole number manipulation
h. Algebra
i. Metric conversions

Performance Objective (CRM)

Suggested Testing Activities And Resources

Reading Skills
- a. Follow directions
- b. Draw conclusions
- c. Interpret instructions
- d. Recognize appropriate reference resources
- e. Locate information in reference materials

Problem Solving Skills
- a. Recognize appropriate reference sources
- b. Locate information in reference materials

Communication Skills
- a. Organize information

TASK OR UNIT COMPETENCY

M-02 Calculating the mechanical advantage of the lever

PERFORMANCE STATEMENT

Calculate the mechanical advantage of the lever.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Levers
    1. First class
    2. Second class
    3. Third class
b. The fulcrum
c. Effort force
d. Resistance force
e. Mechanical advantage
f. Ratios and fractions
g. English metric conversions
h. Measurement
i. Factoring

Provide Demonstration On:

a. Computing the mechanical advantage of the lever using ratios and fractions
b. The mechanical advantage of the lever by manipulating the fulcrum and weights

Provide Practical Application On:

Using the three classes of levers to gain a mechanical advantage

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Balance lever
b. Triangular fulcrum
c. Weights
d. Ruler

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram containing various levers with a specified resistance force, the student will identify the effort force with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the mechanical advantage of the lever.

b. Students should be given a performance test to assess their ability to construct the three classes of levers.

c. Use resources provided in the Instructional Materials section on the previous page.

Math Skills
a. Ratios, proportions and percents
b. Measurement
c. Fraction and decimal usage and conversions
d. Whole number manipulation
e. Metric conversions
f. Algebra

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Recognize appropriate reference resources
e. Locate information in reference materials

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Estimate outcomes, with or without measurements
d. Draw conclusions

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

M-03 Using the lever

PERFORMANCE STATEMENT

Use the lever.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. First class levers
b. Second class levers
c. Third class levers
d. Mechanical advantage
    1. Force
    2. Distance moved
    3. Length of lever arm
    4. Fulcrum
    5. Resistance
    6. Effort
    7. Ratios

Provide Demonstration On:

a. Using first class levers to increase force
b. Using second class levers to gain strength
c. Using third class levers to gain speed and distance

Provide Practical Application On:

Using levers to gain mechanical advantage in robotic arms and hydraulic hoists

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Power experimenter trainer
b. Calculator
c. Various examples of levers

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a power experimenter containing schematics, diagrams and materials, the student will identify and construct the three classes of levers with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use the three classes of levers to gain a mechanical advantage.

b. Students should be given a performance test to assess their ability to construct the three classes of levers.

Math Skills
a. Organize data into tables, charts and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Problem Solving Skills
a. Recognize cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

M-04 Calculating the mechanical advantage of the wheel and axle

PERFORMANCE STATEMENT

Calculate the mechanical advantage of the wheel and axle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The wheel and axle
   1. To transmit force
   2. To produce a change in speed
b. The radius of a circle
c. The circumference of a circle
d. The diameter of a circle
e. The fulcrum
f. Class one levers
g. Mechanical advantage
h. Ratios and fractions
i. English to metric conversions
j. Measurement
k. Factoring

Provide Demonstration On:

a. How a wheel and axle is used to gain mechanical force by using ratios and fractions
b. How a wheel and axle is used to produce a change in speed by using ratios and fractions

Provide Practical Application On:

Using the wheel and axle to transmit force and change speed

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Wheels and axles
b. Rope or wire
c. Weights
d. Spring balance
e. Measuring rule

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram containing several different diameters of wheels and axles, the student will calculate the mechanical advantage with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the mechanical advantage of the lever.

b. Students should be given a performance test to assess their ability to apply the wheel and axle to transmit force and to produce a change in speed.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Squares and square roots
d. Apply formulas
e. Interpret graphic data
f. Identify geometric relations and properties
Problem Solving Skills
a. Recognzie appropriate reference sources
b. Locate information in reference materials
c. Estimate outcomes, with or without units or measurements
d. Draw conclusions
e. Recognize relevance of data
f. Interpret graphic data
g. Make predictions, generalizations and comparisons

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

M-05 Using the wheel and axle

PERFORMANCE STATEMENT

Use the wheel and axle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wheels and axles
b. Levers
c. Fulcrums
d. Mechanical advantage
    1. Ratios
    2. Torque
    3. Speed
    4. Force
    5. Distance moved
    6. Resistance
    7. Effort
    8. Diameter
    9. Circumference
e. Gears
f. V velt assemblys
g. Roller chain assemblys
h. Sprockets
i. Timing belts

Provide Demonstration On:

a. Using the wheel and axle to increase force
b. Using the wheel and axle to increase speed
c. Using the wheel and axle to change direction

Provide Practical Application On:

a. Using the wheel and axle in the form of gears in gear boxes, metal lathes, transmissions and rear axle assemblys
b. Using V belts used in drill presses, washing machines and other machinery

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and McDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamental of Applied Physics

Tools and Equipment:

a. Power experimenter trainer
b. Various examples of the wheel and axle used in machines
c. Calculator

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a power experimenter containing diagrams, schematics and materials, the student will identify and construct three working models of the wheel and axle to increase force, increase speed and change direction with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to construct different versions of the wheel and axle to increase force, speed and change direction.

b. Students should be given a performance test to assess their ability to use different versions of the wheel and axle to gain a mechanical advantage.

Math Skills
a. Organize data into graphs, charts and tables
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Problem Solving Skills
a. Recognize cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
e. Calculate mechanical advantages
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

M-06 Calculating the mechanical advantage of the inclined plane and wedge

PERFORMANCE STATEMENT

Calculate the mechanical advantage of the inclined plane and wedge.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mechanical advantage
b. Slope
c. Force
    1. Resistance
    2. Effort
d. Vertical rise
e. Ratios and fractions
f. Right angle trigonometry
g. Measurement
h. Factoring

Provide Demonstration On:

Computing the mechanical advantage of a wedge and inclined plane using ratios and fractions

Provide Practical Application On:

a. The use of an inclined plane in the form of a ramp to gain a mechanical advantage
b. The use of a wedge to gain a mechanical advantage

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Adjustable inclined plane
b. Car (model car; actual car can be used)
c. Spring balance
d. Weights

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram containing several different wedges and inclined planes, the student will calculate the mechanical advantage with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the mechanical advantage of the inclined plane and wedge.

b. Use resources provided in the Instructional Materials section on the previous page.

Math Skills
a. Ratios, proportions, and percents
b. Measurement
c. Fractions and decimal usage and conversions
d. Whole number manipulation
e. Metric conversions
f. Geometry
g. Trigonometry
  1. Right angles
  2. Sine, cosine, tangent formulas
  3. Table of trigonometric functions
h. Algebra

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

M-07 Using the wedge

PERFORMANCE STATEMENT

Use the wedge.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The inclined plane
b. Mechanical advantage
    1. Slope
    2. Force
    3. Effort
    4. Resistance
    5. Distance
    6. Ratio
    7. Length
c. Right angle trignometry

Provide Demonstration On:

a. The relationship of the wedge and the inclined plane
b. Using the wedge to cut and pierce
c. Using the wedge to apply force and pressure

Provide Practical Application On:

a. Using the wedge gear in washing machine agitators
b. Using the wedge in air hammers and wood splitters to cut and pierce

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Power experimenter trainer
b. Calculator
c. Washing machine agitator
d. Various example of wedges

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given problems calculating the mechanical advantage of the wedge, the student will solve the problems with 80% accuracy.

Suggested Testing Activities And Resources

Students should be given a written test to assess their knowledge of the wedge.

Math Skills
a. Algebra
b. Decimals and fractions usage and conversions
c. Whole number manipulation
Reading Skills
a. Recognize cause and effect relationships
b. Locate information in reference materials
Problem Solving Skills
a. Recognize cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
e. Calculate mechanical advantages
Communication Skills
a. Organize information
b. Compose sentences
c. Write paragraphs

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TASK OR UNIT COMPETENCY

M-08 Transmitting and calculating force and motion with the screw thread

PERFORMANCE STATEMENT

Transmit and calculate force and motion with the screw thread.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Screws
  1. Threads
  2. Pitch
  3. Helix angle
b. Inclined plane
c. Effort force
d. Resistance force
e. Mechanical advantage
f. Ratios and fractions
g. English metric conversions
h. Measurement
i. Right angle trigonometry
j. Factoring

Provide Demonstration On:

a. Calculating the mechanical advantage of the screw
b. Using the screw in making measurements and adjustments

Provide Practical Application On:

a. Jack screw
b. Micrometers used for measurements

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Micrometers
b. Screw thread plate, with coarse and fine pitch screws
c. Rule
d. Jack screw
e. Weights

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram containing a jack screw with a given pitch and handle length, the student will claculate the mechanical advantage with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the mechanical advantage of the screw thread.

b. Use resources provided in the Instructional Materials section on the previous page.

Math Skills

a. Ratios, proportions, and percents
b. Measurement
c. Fractions and decimal usage and conversions
d. Whole number manipulation
e. Metric conversions
f. Geometry
g. Trigonometry
    1. Right angles
    2. Sine, cosine, tangent formulas
    3. Table of trigonometric functions
h. Algebra

Reading Skills

a. Draw conclusions
b. Interpret graphic information
c. Recognize relevance of data
d. Recognize appropriate reference resources
e. Locate information in reference materials

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

M-09 Using the screw

PERFORMANCE STATEMENT

Use the screw.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. The inclined plane
- b. Mechanical advantage
  - 1. Effort
  - 2. Resistance
  - 3. Force
  - 4. Ratios
- c. Pitch
- d. Threads
- e. Worm gears
- f. Augers
- g. Right angle trigonometry

Provide Demonstration On:

- a. Using the screw to convert rotary motion into straight line motion
- b. Using the screw to press or fasten objects
- c. The relationship of the screw and the inclined plane

Provide Practical Application On:

- a. Using fans in electric motors
- b. Using augers to move materials
- c. Using screws for adjustments in measures, machines and tools

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Bond and MacDonald, Power: Mechanics of Energy
- b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

- a. Power experimenter trainer
- b. Various fans
- c. Augers
- d. Various examples of machines and tools using screw adjustments
- e. Calculator

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a power experimenter containing diagrams, schematics and materials, the student will construct working models of the screw converting rotary motion to straight line motion and to press and fasten objects with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the screw.

b. Students should be given a performance test to assess their ability to use the screw to press, fasten and convert rotary motion to straight line motion.

Math Skills
a. Organize data into tables, charts and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Problem Solving Skills
a. Recognize cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
e. Calculate mechanical advantages
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

M-10 Calculating the mechanical advantage of the pulley system

PERFORMANCE STATEMENT

Calculate the mechanical advantage of the pulley system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pulleys
   1. Fixed
   2. Movable
   3. Block and tackle
   4. Sheave
b. Mechanical advantage
c. Resistance force
d. Effort force
e. Ratios and fractions
f. English to metric conversions
g. Factoring

Provide Demonstration On:

Calculating the mechanical advantage of pulley systems

Provide Practical Application On:

Using pulley systems to gain a mechanical advantage

INSTRUCTIONAL MATERIALS

Textbooks:

a. Bond and MacDonald, Power: Mechanics of Energy
b. Olivo and Olivo, Fundamentals of Applied Physics

Tools and Equipment:

a. Pulleys
   1. Fixed
   2. Movable
   3. Block and tackle
   4. Sheave
b. Ropes
c. Weights
d. Spring balance

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a diagram containing several different combinations of fixed and movable pulleys, the student will calculate the mechanical advantage with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the mechanical advantage of pulleys.

b. Students should be given a performance test to assess their ability to construct various pulley systems.

c. Use resources provided in the Instructional Materials section on the previous page.

Math Skills
a. Ratios, proportions and percents
b. Measurement
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
Reading Skills
a. Draw conclusions
b. Interpret graphic information
c. Recognize relevance of data
d. Recognize appropriate reference resources
e. Locate information in reference materials
Problem Solving Skills
a. Recognize appropriate reference resources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data
Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

ES-01 Discussing and demonstrating how to get a job

PERFORMANCE STATEMENT

Discuss and demonstrate how to get a job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. How a job search is conducted
b. How to write a resume
c. The steps involved in preparing for a job interview
d. What actually happens during a job interview

Provide Demonstration On:

a. Assessing abilities and interests
b. Identifying job contacts
c. Obtaining necessary documents for securing employment
d. Writing a resume
e. Applying for a job
f. Researching and evaluating potential employer
g. Preparing questions for an interview
h. Dressing appropriately for a job interview
i. What items and types of information to take to a job interview
j. How to conduct oneself on an interview

Provide Practical Application On:

a. Writing a resume
b. Filling out job applications
c. Simulating a job interview situation

INSTRUCTIONAL MATERIALS

Textbooks:

Georgia, Electromechanical Technology Curriculum Guide (Refer to the Employability Skills section.)

Tools and Equipment:

a. Necessary documents (birth certificate, social security card, work permit)
b. Job resource documents (newspaper, magazine, etc.)
c. Bulletin board

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

Performance Objective (CRM)

Given necessary information and supplies, the student will discuss and demonstrate how to get a job with 90% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to demonstrate how to get a job. Check the procedures used and the results obtained.

b. Using appropriate written testing procedures, have students demonstrate a knowledge of: how a job search is conducted; the steps involved in preparing for a job interview; and what actually happens during a job interview.

c. Use resources provided in the Instructional Materials section on the previous page.

TASK OR UNIT COMPETENCY

ES-02 Discussing and demonstrating how to keep a job

PERFORMANCE STATEMENT

Discuss and demonstrate how to keep a job.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Job responsibilities
b. Job attitudes
c. Reasons people are fired

Provide Demonstration On:

a. Types of job responsibilities
b. Types of job attitudes
c. Reasons people are fired

Provide Practical Application On:

a. Desirable employability characteristics
b. Undesirable employability characteristics

INSTRUCTIONAL MATERIALS

Textbooks:

Georgia, Electromechanical Technology Curriculum Guide (Refer to the Employability section.)

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given necessary information, the student will discuss and demonstrate how to keep a job with 90% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to demonstrate how to keep a job. Check the procedures used and the results obtained.

b. Using appropriate written testing procedures, have students demonstrate a knowledge of: job responsibilities; job attitutes; and reasons people are fired.

c. Use resources provided in the Instructional Materials section on the previous page.

TASK OR UNIT COMPETENCY

RW-01 Demonstrating a knowledge of the residential wiring occupation

PERFORMANCE STATEMENT

Demonstrate a knowledge of the residential wiring occupation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terms associated with the occupational introduction to residential wiring
b. Job responsibilities of residential electricians
c. Occupational hazards of residential electricians
d. Required characteristics for a student in a residential wiring program
e. Undesirable working situations for residential electricians
f. Facts concerning the occupational outlook for residential electricians
g. Employment possibilities for a student in a residential wiring program

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 0

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a written test, the student will demonstrate a knowledge of the residential wiring occupation with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of terms related to the residential wiring occupation in addition to job responsibilities, characteristics and employment possibilities in the field.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas and details
b. Make predictions, generalizations and comparsons
c. Draw conclusions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
g. Interpret career information
Communication Skills
a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

RW-02 Identifying electrical safety terms and practices

PERFORMANCE STATEMENT

Identify electrical safety terms and practices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terms associated with electrical safety
b. Safety signs or tags and their color codes
c. Two major causes of electrical accidents
d. Basic electrical safety practices
e. Electrical fire prevention practices
f. Safety practices for step ladders
g. Safety practices for job built and extension ladders
h. Safety practices for manual hand tools
i. Safety practices for electrical hand tools
j. Proper and improper dress for electrical work
k. Proper lifting techniques
l. Facts about the importance of the third wire
m. Ground-fault interrupters

(continued on next page)

Provide Demonstration On:

Electrical safety practices

Provide Practical Application On:

Demonstrating safety practices in the lab

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued on next page)

n. Safe and unsafe practices for working around live circuits
o. Rescue procedures in case of electrical accidents
p. Ampere figures at 120v, 60 hertz (cycle) and its effect on the human body

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a written and/or performance test, the student will identify electrical safety terms and practices with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of electrical safety terms and practices.

b. Students should be given a performance test to assess their ability to demonstrate electrical safety practices in the lab.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interprets graphic information, instructions and labeling information
f. Recognize relevance of data
g. Recognize appropriate reference materials
h. Locate information in reference materials
i. Distinguish between fact and opinion

Problem Solving Skills

a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Recognize appropriate reference resources
d. Locate information in reference materials
e. Estimate outcomes
f. Draw conclusions
g. Interpret non-graphic information
h. Recognize relevance of data
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-03 Identifying and using electrical wiring specialty tools

PERFORMANCE STATEMENT

Identify and use electrical wiring specialty tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Specialty tools used in residential wiring
b. Specialty tools and their correct uses
c. Care of specialty tools
d. The ability to:
    1. Use a soldering gun to splice conductors
    2. Set up and use a hacksaw
    3. Use a knockout punch
    4. Use a volt ohmmeter
    5. Use a clamp-on ammeter
    6. Bend a 90° stub with 1/2" EMT
    7. Ream rigid conduit
    8. Cut rigid conduit with a pipe cutter

Provide Demonstration On:

The proper use of electrical hand tools

Provide Practical Application On:

Using electrical wiring specialty tools

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas

Tools and Equipment:

a. Soldering gun
b. Hacksaw
c. Knockout punch
d. VOM
e. Clamp-on ammeter
f. Conduit
g. Pipe cutter

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given assorted tools and equipment, the student will demonstrate the ability to use electrical wiring specialty tools with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use electrical wiring specialty tools.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Recognize main ideas, details, sequence of events and cause and effect relation relationships
c. Draw conclusions
d. Interpret graphic information
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Law of exponents
c. Ratios, proportions and percents
d. Whole number manipulation
e. Select appropriate operations for a given problem situation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimates outcomes
e. Interpret non-graphic information
f. Recognize relevance of data
g. Interpret graphic information
h. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-04 Using the National Electrical Code manual

PERFORMANCE STATEMENT

Use the National Electrical Code manual.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The National Electrical Code (NEC)
b. The purpose of the NEC
c. The chapter arrangement of the NEC
d. General facts about the NEC
e. The six steps used in the cross reference system of the NEC

Provide Demonstration On:

How to use the National Electrical Code manual

Provide Practical Application On:

a. Using the National Electrical Code manual
b. Answering questions related to residential wiring practices
c. Locating allowable ampacities for various conductors
d. Interpreting conduit fill tables

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics
d. Summers, National Electrical Code

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a National Electrical Code, the student will demonstrate an ability to use the manual by discussing, locating and interpreting various NEC information with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding how to use the National Electrical Code.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Follow directions
d. Make predictions, generalizations and comparisons
e. Draw conclusions
f. Interpret graphic information
g. Recognize relevance of data
h. Recognize appropriate reference resources
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
Problem Solving Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Recognize appropriate reference sources
d. Locate information in reference materials
e. Estimate outcomes
f. Draw conclusions
g. Interpret graphic information
h. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-05 Identifying conductors, cables and cords

PERFORMANCE STATEMENT

Identify conductors, cables and cords.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terms associated with cables and conductors
b. Letter type designations for conductor insulations
c. The size classification of conductors
d. Conductors commonly found in residential wiring
e. The letter type designations for insulation when given installation conditions for conductors and cables
f. Types of cables commonly found in residential wiring
g. Cables and their uses in residential wiring
h. Facts about cords and their conductors
i. Facts about cables and their conductors

Provide Demonstration On:

Types of conductors, cables and cords

Provide Practical Application On:

a. Various types of conductors, cables and cords
b. Determining the sizes of conductors
c. Selecting conductors and cables found in residential wiring

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics
d. Summers, National Electrical Code

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas

Tools and Equipment:

a. Cables
b. Cords
c. Conductors

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an assortment of conductors, cables, cords and a National Electrical Code manual, the student will identify sizes and types of wires and insulation for a given residential wiring job with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of terms related to conductors, cables and cords.

b. Students should be given a performance test to assess their ability to select conductors, cords and cables for a given residential wiring job.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Follow directions
d. make predictions, generalizations and comparisons
e. Draw conclusions
f. Interpret graphic information
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Metric conversions

(continued on next page)

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving

a. Distinguish between fact and opinion
b. Recognize main ideas, sequence of events and cause and effect relationships
c. Locate information in reference materials
d. Recognize appropriate reference sources
e. Estimate outcomes
f. Draw conclusions
g. Interprets non-graphic information
h. Recognize relevance of data
i. Interpret graphic information
j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-06 Reading blueprints and rules

PERFORMANCE STATEMENT

Read blueprints and rules.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terms associated with blueprints and specifications
b. Blueprint symbols used in residential drawings
c. Electrical blueprint symbols
d. The names of types of lines used on blueprints
e. Kinds of information commonly found in blueprint specifications
f. Steps in reading a rule
g. Reading a rule
h. Measuring objects using a rule

Provide Demonstration On:

a. How to read a blueprint
b. How to read a rule

Provide Practical Application On:

a. Identifying blueprint symbols
b. Identifying electrical symbols
c. Reading a rule
d. Measuring objects using a rule

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Buildings and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

A/Vs:

Georgia, "Reading a Basic Schematic Diagram" (ST); "Identify Residential Wiring Symbols and Designing Circuits" (ST)

Student Manuals:

a. AAVIM, Electrical Wiring: Residential, Utility Buildings and Service Areas
b. Georgia, Residential Electrical Wiring, Unit REW-12
c. MAVCC, Residential Wiring

Tools and Equipment:

a. Blueprints
b. Rule

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given proper tools and equipment, the student will interpret blueprints with 80% accuracy and read a rule with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of terms associated with blueprints and of the symbols used in blueprints.

b. Students should be given a performance test to assess their ability to interpret blueprints and to read a rule.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Make predictions, generalizations and comparisons
c. Interpret graphic information
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials

Math Skills
a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Metric conversions
f. Squares and square roots
g. Measurement
h. Interpret graphic information
i. Read a rule

Problem Solving Skills
a. Recognize main ideas, details and sequence of events
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Recognize relevance of data
g. Organize data into graphs
h. Interprets graphic data
i. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-07 Identifying and drawing electrical symbols used in residential wiring

PERFORMANCE STATEMENT

Identify and draw electrical symbols used in residential wiring.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical symbols
b. Designing and drawing circuits
    1. Drawing symbols
    2. Drawing wiring
    3. NEC standards
c. Using the power formula to figure amperage

Provide Demonstration On:

Working example power formula problems to figure amperage

Provide Practical Application On:

a. Drawing convenience outlets onto a floor plan according to NEC standards
b. Identifying electrical symbols on a chart
c. Drawing all appliance outlets on a floor plan according to NEC standards
d. Drawing 220v outlets on a floor plan according to NEC standards

INSTRUCTIONAL MATERIALS

Textbooks:

Summers, National Electrical Code

A/Vs:

Georgia, "Identifying Residential Wiring Symbols and Designing Circuits" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Secondary, Unit REW-12
b. MAVCC, Residential Wiring

Tools and Equipment:

Blueprints

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a floor plan, the student will draw all electrical symbols and wiring circuits according to NEC standards. The instructor will evaluate the student's work according to established criteria.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to identify and draw electrical symbols used in residential wiring.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Law of exponents
c. Ratios, proportions and percents
d. Fractions and decimals usage and conversions
e. Whole number manipulation
f. Algebra
g. Metric conversion
h. Squares and square roots
i. Applies formulas
j. Estimates results
k. Interpret graphic data
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources

Performance Objective (CRM)

Suggested Testing Activities And Resources

c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Recognize relevance of data
g. Organizes data into graphic information
h. Interpret graphic information
i. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-08 Identifying boxes and devices used in electrical wiring

PERFORMANCE STATEMENT

Identify boxes and devices used in electrical wiring.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Boxes used in residential wiring
b. Design features that need to be considered when selecting boxes
c. Devices commonly used in residential wiring
d. Covers and plates used in residential wiring
e. Common supports and anchors
f. Common screws, bolts, nuts, and nails
g. Common connectors, terminals, and lugs
h. Factors to consider when selecting connectors, terminals, and lugs

Provide Demonstration On:

Boxes and devices and their uses

Provide Practical Application On:

Identifying boxes and devices used in electrical wiring

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Buildings and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Buildings and Service Areas

Tools and Equipment:

a. Boxes
b. Covers
c. Plates
d. Supports
e. Anchors
f. Screws
g. Bolts
h. Nuts
i. Nails
j. Connectors
k. Terminals
l. Lugs

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the proper materials and equipment, the student will match boxes and devices and identify their function with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to match boxes and devices and explain their functions.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Interpret graphic information
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Fractions and decimals usage and conversions
c. Ratios, proportions and percents
Problem Solving Skills
a. Recognize main ideas and details
b. Recognize appropriate references sources
c. Locate information in reference materials
d. Draw conclusions
e. Recognize relevance of data
f. Interpret graphic information
g. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-09 Installing load centers

PERFORMANCE STATEMENT

Install load centers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terms associated with load centers
b. Types of safety switch enclosures
c. Common load center accessories
d. Possible installations for load centers
e. The parts of a fusible load center
f. The parts of a breaker load center
g. Safety rules for working around load centers and safety switches
h. Common panel interior configurations

Provide Demonstration On:

a. Types of load centers
b. Possible installation of load centers

Provide Practical Application On:

a. Identifying load center types, parts and accessories
b. Safely installing load center

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Buildings and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Buildings and Service Areas

Tools and Equipment:

a. Load center accessories
b. Load center parts

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the proper tools, equipment and materials, the student will install a load center with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the terms associated with load centers.

b. Students should be given a performance test to assess their ability to install a load center.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas and details
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions

Problem Solving Skills
a. Recognize main ideas and details
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-10 Identifying and installing overcurrent protection devices

PERFORMANCE STATEMENT

Identify and install overcurrent protection devices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of overcurrent protection devices
b. Function of overcurrent protection devices
c. Operation of overcurrent protection devices
d. Installation procedures

Provide Demonstration On:

Selecting overcurrent protection devices for a given job

Provide Practical Application On:

Installing types of overcurrent protection devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas
b. Alerich, Electrical Construction Wiring
c. Miller and Culpepper, Energy: Electricity/Electronics

Student Manuals:

AAVIM, Electrical Wiring: Residential, Utility Building and Service Areas

Tools and Equipment:

Assorted overcurrent protection devices

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given tools and equipment, the student will install a single element fuse and a time delay fuse according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select overcurrent protection devices for a given job situation.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion
e. Algebra

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Interpret graphic information
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-11 Designing and installing lighting circuits

PERFORMANCE STATEMENT

Design and install lighting circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The distribution panel
  1. Purpose
  2. Breakers
  3. Service switch
  4. Ground bar
  5. Distribution terminals
b. Connecting wiring to the panel
c. Wiring a switch
d. Wiring a lighting box and light fixture

Provide Demonstration On:

Installing a light fixture

Provide Practical Application On:

a. Drawing a circuit consisting of distribution panel and connections, a switch and one light
b. Drawing a circuit with two lights
c Wiring a lighting circuit with one light
d. Wiring a lighting circuit with two lights

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Bergwall, "Receptacle and Ground Fault Interrupters" (FS)
b. Georgia, "Installing Lighting Outlet" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-03a
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Switch
b. Lighting box
c. Light fixture
d. Wire
e. Breakers
f. Tool kit

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

a. Given appropriate tools, supplies and materials, the student will design, wire and install a lighting circuit consisting of a switch and one light fixture. The student will test the circuit for proper and safe operation.

b. Given appropriate tools, supplies and materials, the student will design, wire and install a lighting circuit consisting of a switch and two light fixtures. The student will test the circuit for proper and safe operation.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to wire and install a lighting circuit.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
f. Interprets data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draws conclusions
f. Interprets instructions
g. Recognize relevance of data
h. Organizes data into graphic information
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Intepret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-12 Designing a circuit and installing a three-way switch

PERFORMANCE STATEMENT

Design a circuit and install a three-way switch.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Three-way switches
    1. Purpose
    2. Circuits
    3. Wiring methods
b. Necessary components of a three-way switch circuit
c. Switches controlling multiple outlets

Provide Demonstration On:

Wiring a three-way switch

Provide Practical Application On:

a. Designing a circuit with two three-way switches controlling two lights
b. Drawing the circuit
c. Wiring the circuit

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Bergwall, "Three-Way and Four-Way Switches" (FS)
b. Georgia, "Installing a Three-Way Switch" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-06
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Two three-way switches
b. Two lighting boxes and fixtures
c. Wire
d. Tools kit
e. VOM

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

Performance Objective (CRM)

Given all necessary tools, supplies and equipment, the student will design, draw and wire a circuit with two three-way switches controlling two lighting outlets. The circuit must meet all NEC standards. The student will test the circuit for proper operation.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to design a circuit and install a three-way switch.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
f. Interprets data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draws conclusions
f. Interprets instructions
g. Recognize relevance of data
h. Organizes data into graphic information
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communication
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-13 Installing a 115v appliance outlet

PERFORMANCE STATEMENT

Install a 115v appliance outlet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reading an appliance nameplate
   1. Type of appliance
   2. Full load amps
   3. Voltage required
   4. Breaker required
   5. Wire size required
b. Designing a 115v appliance outlet circuit
c. Pigtail grounding connections
d. Grounding receptacles
e. Ground fault interrupter (GFI)
f. Locating the outlet
g. Reason for a separate appliance circuit
h. Wall boxes
   1. Metal
   2. Plastic
i. Wire types and sizes
j. Determining wire and breaker sizes

Provide Demonstration On:

Mounting a breaker in a distribution panel

Provide Practical Application On:

a. Drawing a circuit for a 115v appliance outlet
b. Installing a 115v appliance outlet

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Bergwall, "Small Appliance Circuits" (FS)
b. Georgia, "Installing 115v Appliance Outlets" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-01
b. MAVCC, Residential Wiring

Tools and Equipment:

a. 115v grounded outlet
b. Outlet box
c. Breakers
d. Wire
e. Tool kit

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given appropriate tools and supplies, the student will wire a 115v appliance outlet according to NEC standards. The following operations will be performed:

1. Mount distribution panel and outlet box.
2. Determine amperage rating of assigned appliance.
3. Select appropriate size breaker and mount in panel.
4. Select proper wire size.
5. Wire the distribution panel and outlet.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a 115v appliance outlet.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Metric conversions
g. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draws conclusions
f. Interprets instructions
g. Recognize relevance of data
h. Organizes data into graphic information
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-14 Installing a convenience outlet

PERFORMANCE STATEMENT

Install a convenience outlet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Difference between convenience and appliance outlets
b. NEC requirements
c. Wiring multiple convenience outlets
d. Locating convenience outlets
e. Color coding of wires

Provide Demonstration On:

Wiring a convenience outlet

Provide Practical Application On:

Drawing a circuit including four convenience outlets which show all hot, neutral and ground wires

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Career Aids, Inc., "House Wiring" (FS)
b. Georgia, "Installing Convenience Outlets" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-02
b. MAVCC, Residential Wiring

Tools and Equipment:

a. 115v convenience outlet
b. Outlet box
c. Breakers
d. Wire
e. Tool kit

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given appropriate tools, supplies and materials, the student will wire a circuit containing four convenience outlets. The student will make all appropriate connections at the distribution panel and outlet boxes and test the circuit for proper and safe operation.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a convenience outlet.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion
e. Squares and square roots

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draws conclusions
f. Interprets instructions
g. Recognize relevance of data
h. Organizes data into graphic information
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-15 Installing a split switched receptacle

PERFORMANCE STATEMENT

Installing a split switched receptacle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of switched receptacles
b. Converting standard switches into split or combination types
c. Manufactured split switches and receptacles
d. Combination switch and receptacle
e. Duplex switches
f. Split-wired duplex receptacle switch
g. Key operated switches
h. AC quiet switches
i. Door switches
j. NEC standards

Provide Demonstration On:

Converting standard switches and receptacles into split or combination types

Provide Practical Application On:

a. Drawing a circuit with a duplex receptacle and a combination receptacle so the receptacle of the combination switch remains hot
b. Wiring the circuit

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

Georgia, "Installing Split and Switched Receptacles" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-04
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Outlet boxes
b. Receptacles
c. Wires
d. Breakers

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given appropriate tools, supplies and materials, the student will design and wire a circuit with a duplex receptacle and a combination receptacle. The outlet on the combination receptacle should always be hot. The installation should be in accordance with NEC standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a split switched receptacle.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions
e. Squares and square roots

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships

b. Recognize appropriate reference sources

c. Locate information in reference materials

d. Estimate outcomes

e. Draws conclusions

f. Interprets instructions

g. Recognize relevance of data

h. Organizes data into graphic information

i. Interprets graphic information

j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences

b. Organize information

c. Interpret aural communications

d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-16 Installing a one-button and a two-button door bell circuit

PERFORMANCE STATEMENT

Install a one-button and a two-button door bell circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bell or buzzer wiring
b. Chime circuits
c. Transformers
d. Push buttons
e. Low-voltage wiring
f. Locating the bell, buzzer or chimes
g. Locating the transformer
h. Front and back door buttons

Provide Demonstration On:

a. Installing a push button
b. Running low voltage wiring

Provide Practical Application On:

a. Drawing a one and a two-button door bell or buzzer circuit
b. Wiring the circuits

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Bergwall, "Installation for Signal System" (FS)
b. Georgia, "Installing a Door Bell Circuit" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-05
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Door bell kit
b. Tool kit
c. VOM

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given all necessary tools and equipment, the student will design and install both a one-button and a two-button door bell or buzzer circuit. The installation must meet manufacturer's specifications. The instructor will check the installation for proper operation.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install various types of door bell circuits.

b. MAVCC, Residential Wiring, Teacher Editions, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret instructions
g. Recognize relevance of data
h. Organize data into graphic information
i Interpret graphic information
j. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-17 Installing 230v circuits and outlets

PERFORMANCE STATEMENT

Install 230v circuits and outlets.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of 230v outlets
b. Junction boxes
c. 230v breakers
   1. Double pole
   2. Single pole
d. Ratings of 230v breaker
e. Wiring a 230v outlet
f. Connections at breaker boxes for 230v

Provide Demonstration On:

Installing 230v breakers

Provide Practical Application On:

a. Selecting the appropriate size breaker, wire and outlet (if any) for a given major appliance
b. Drawing a hot water heater circuit
c. Wiring a hot water heater
d. Drawing a circuit for a 230v receptacle and wiring both a flush and a surface mount receptacle

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Bergwall, "Special Purpose Outlets" (FS)
b. Georgia, "Installing 230v Circuits and Outlets" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-07
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Tool kit
b. Wire
c. 230v breakers
d. Surface mount receptacle
e. Flush mount receptacle
f. Hot water heater
g. VOM

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 12

Performance Objective (CRM)

a. Given necessary tools, supplies and equipment, the student will correctly wire a 230v hot water heater according to NEC standards. The student will test the circuit for proper operation.

b. Given necessary tools, supplies and euqipment, the student will wire a circuit for and install a:
    1. Surface mount 230v receptacle
    2. Flush mount 230v receptacle
The student will test the receptacels for proper voltage and will check all connections for safe operation.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install 230v circuits and outlets.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions
e. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
- a. Recognize main ideas, details, sequence of events and cause and effect relationships
- b. Recognize appropriate reference sources
- c. Locate information in reference materials
- d. Estimate outcomes
- e. Draws conclusions
- f. Interprets instructions
- g. Recognize relevance of data
- h. Organizes data into graphic information
- i. Interprets graphic information
- j. Make predictions, generalizations and comparisons

Communication Skills
- a. Compose sentences
- b. Organize information
- c. Interpret aural communications
- d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-18 Installing a temporary service entrance

PERFORMANCE STATEMENT

Install a temporary service entrance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Temporary service
   1. Purpose
   2. Voltage
   3. Amperage
   4. Entrance cable and straps
b. Utility supplied equipment
   1. Clevis
   2. Meter
c. Meter base
d. Weatherproof
   1. Switch
   2. Connections
   3. 203 and 110 volt outlet

Provide Demonstration On:

a. Strapping the entrance cable
b. Installing the ground wire and electrode

Provide Practical Application On:

a. Designing, drawing and labeling a temporary service pole installation
b. Wiring a temporary service pole

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Career Aids, Inc., "Making a Temporary Entrance" (FS)
b. Georgia, "Temporary Service" (ST)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-09
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Tool kit
b. VOM
c. Post-hole diggers
d. Cable
e. Straps
f. Conduit
g. Meter base
h. Breaker or switch box
i. 230 and 110v outlet (weatherproof)
j. Ground wire and electrode

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given all necessary tools, supplies and equipment, the student will install and wire a temporary service pole according to NEC standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a temporary service entrance.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions
e. Squares and square roots
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret instructions
g. Recognize relevance of data
h. Organize data into graphic information
i. Interpret graphic information
j. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills:

a. Compose sentences
b. Organize information
c. Interpret aural communication
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RW-19 Installing a service entrance

PERFORMANCE STATEMENT

Install a service entrance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Source of electrical power
   1. Voltage
   2. Amperage
   3. 60 cycle
b. Entrance cable
   1. Description
   2. Size US amperage
c. Entrance installation methods
d. NEC requirements
e. Components of a service entrance

Provide Demonstration On:

a. Installing the meter base
b. Proper installation of the mast

Provide Practical Application On:

a. Drawing and labeling the components of a service entrance to the distribution panel
b. Installing a service entrance including the meter base, mast, weatherhead and service entrance wire

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich, Electrical Construction Wiring

A/Vs:

a. Georgia, "Installing Service Entrance" (ST)
b. Singer, "Electrical Service Entrance" (FS)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-08
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Tool kit
b. Meter base
c. Weatherhead
d. Mast
e. Wire
f. Inhibitor paste
g. VOM

ESTIMATED CLASS HOURS 8

ESTIMATED LAB HOURS 12

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given all necessary tools, equipment and supplies, the student will install an electrical service entrance (for a residential application) to the distribution panel. The student must observe all NEC standards and safety precautions.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a service entrance.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversions
f. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draws conclusions
f. Interprets instructions
g. Recognize relevance of data
h. Organizes data into graphic information
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

2

TASK OR UNIT COMPETENCY

RW-20 Estimating materials for a given residential wiring installation

PERFORMANCE STATEMENT

Estimate materials for a given residential wiring installation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Preparing a materials estimate
b. Wall and ceiling boxes for all outlets
c. Wire for feed and switch legs
d. Panel size
e. Breakers
f. Connectors
g. Length of wire required

Provide Demonstration On:

Preparing a materials list

Provide Practical Application On:

Making a materials estimate and drawing the symbols and circuits onto a floor plan

INSTRUCTIONAL MATERIALS

A/Vs:

Bergwall, "Estimating the Job" (FS)

Student Manuals:

a. Georgia, Residential Electrical Wiring, Unit REW-13
b. MAVCC, Residential Wiring

Tools and Equipment:

a. Floor plan
b. Materials price list

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 15

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a floor plan and a materials price list, the student will prepare a materials estimate for the installation and draw all symbols and circuits onto the floor plan according to NEC standards.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of how to prepare a materials estimate for a given floor plan.

b. MAVCC, Residential Wiring, Teacher Edition, 1978.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details and sequence of events
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions and graphic information
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Metric conversion
g. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draws conclusions
f. Interprets instructions
g. Recognize relevance of data
h. Organizes data into graphic information
i. Interprets graphic information
j. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-01 Identifying career opportunities available in refrigeration

PERFORMANCE STATEMENT

Identify career opportunities available in refrigeration.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Various types of refrigeration units
b. Job potential as related to the refrigeration and air conditioning field
c. Section III of this Curriculum Guide

Provide Demonstration On:

Different types of refrigeration systems and their best use by the consumer

Provide Practical Application On:

Observing various types of refrigeration systems in lab area

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Department of Labor, Occupational Outlook Handbook
c. Doolin, Doolin's Troublehooter's Bible
d. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, Refrigeration, Unit REF-01

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Having been provided with occupational information, the student will identify and discuss, with 80% accuracy, career opportunities available in the refrigeration field.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of job opportunities in the refrigeration industry.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Follow directions
d. Make predictions, generalizations and comparisons
e. Draw conclusions
f. Interpret occupational and career information
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Recognize relevance of data
f. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-02 Identifying safe working conditions

PERFORMANCE STATEMENT

Identify safe working conditions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Shop safety rules
b. Protective clothing
c. Fire hazards
d. Electrical hazards
e. Freon hazards
f. Types of safety equipment
    1. Fire extinguishers
    2. Clothing
    3. First aid supplies
g. First aid

Provide Demonstration On:

a. Using safety equipment
b. Proper handling of equipment
c. First aid

Provide Practical Application On:

a. Handling fire extinguishers
b. First aid practices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Carrier Corp., A Safety Guide for Refrigeration and Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Identifying Safe Working Conditions" (ST)

Student Manuals:

Georgia, Refrigeration, Unit REF-02

Tools and Equipment:

a. Fire extinguishers
b. First aid supplies

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of standard shop materials, equipment and practices, the student will identify with 100% accuracy, safe and unsafe practices and precautionary measures to be taken to prevent hazardous situations.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of good safety practices. Students should be retested on incorrect items.

b. Students should be given a performance test to assess their ability to apply good safety practices.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Follow directions
d. Make predictions, generalizations and comparisons
e. Draw conclusions
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Metric conversions

Problem Solving Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events, and cause and effect relationships
c. Recognize appropriate reference sources
d. Locate information in reference materials
e. Estimate outcomes, with or without units or measurements
f. Draw conclusions
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RE-03 Demonstrating a knowledge of basic refrigeration concepts

PERFORMANCE STATEMENT

Demonstrate a knowledge of basic refrigeration concepts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Heat, energy and cold
b. Refrigeration effect
c. Three types of heat
d. Heat measurement
e. F. and C. conversions
f. B.T.U.
g. Three ways of heat transfer
h. Ambient temperature
i. Gauge pressures
j. Boiling point
k. Thermostat
l. Compressor
m. Melting point
n. Liquefaction
o. Vaporization
p. Condensation

Provide Demonstration On:

a. Methods of heat transfer
b. Centigrade and fahrenheit conversions
c. Measuring temperatures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, *Modern Refrigeration and Air Conditioning*
b. Prentice-Hall, *Refrigeration and Air Conditioning*

A/Vs:

Georgia, "Understanding Basic Refrigeration Concepts" (ST)

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, *Refrigeration*, Unit REF-03

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 0

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of the basic terms and principles used in refrigeration, the student will match the terms and principles with their definitions with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding basic refrigeration concepts.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Follow directions
d. Make predictions, generalizations and comparisons
e. Draw conclusions
f. Interpret graphic information
g. Interpret instructions
h. Recognize relevance of data
i. Recognize appropriate reference resources
j. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
f. Apply formulas
g. Interpret graphic data

Problem Solving Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events, and cause and effect relationships
c. Recognize appropriate reference sources
d. Locate information in reference materials
e. Draw conclusions
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-04 Demonstrating a knowledge of the basic refrigeration cycle

PERFORMANCE STATEMENT

Demonstrate a knowledge of the basic refrigeration cycle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor, condenser, metering device and evaporator
b. Various pressures and temperatures during the refrigeration cycle
c. Transfer and types of heat
d. Theory of condensation
e. Sub-cooling
f. Freons
g. Conditions of refrigerant during the refrigeration cycle

Provide Demonstration On:

a. Major and minor components of the refrigeration cycle
b. Conditions of the refrigerant during the refrigeration cycle

Provide Practical Application On:

Identifying components and their functions on a refrigeration trainer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Understanding the Basic Refrigeration Cycle" (ST)

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, Refrigeration, REF-04

Tools and Equipment:

Refrigeration trainer

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigeration trainer, diagrams of the refrigeration system, or an actual refrigeration unit, the student will identify the purpose and function of each component in the system, explain the heat transfer process and describe the condition of the refrigerant during each stage of the refrigeration cycle with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding the basic refrigeration cycle.

b. Students should be given a performance test to assess their ability to identify major and minor components of the refrigeration cycle.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Whole number manipulation
b. Metric conversions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Interpret graphic data
h. Make predictions, generalizations and comparisons

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-05 Identifying and using refrigeration tools

PERFORMANCE STATEMENT

Identify and use refrigeration tools.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electric drill
b. Bench grinder
c. Hand tools
d. Detecting faults and safety features on various hand tools
e. Thermometers
f. Pressure gauges
g. Tubing cutter

Provide Demonstration On:

Various tools used in refrigeration

Provide Practical Application On:

Various tools used on the refrigeration trainer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Identifying Tools" (ST)

Student Manuals:

Georgia, Refrigeration, Unit REF-05

Tools and Equipment:

a. Hand tools
b. Electric grinder
c. Electric drill
d. Refrigeration trainer

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of various tools used in refrigeration and a refrigeration trainer, the student will demonstrate the correct application for a tool and a given job with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to identify and use various tools on a refrigeration trainer.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Whole number manipulation
b. Metric conversions
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-06 Tapping, threading and replacing threads

PERFORMANCE STATEMENT

Tap, thread and replace threads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tapping and threading
b. Types of bolts and pipes
c. Washers and nuts
d. Standard and metric threads
e. Types of screwdrivers
f. Threads per inch on galvanized and black pipe
g. Self-tapping screws
h. Sizing bits for tapping threads
i. Pipefitting

Provide Demonstration On:

Tapping and threading

Provide Practical Application On:

a. Tapping and threading
b. Tapping and threading galvanized black pipe

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Tapping, Threading and Replacing Threads" (ST)

Student Manuals:

Georgia, Refrigeration, Unit REF-06

Tools and Equipment:

a. Hand tools
b. Tapping and die sets
c. Vice
d. Assorted screws and bolts
e. Assorted fittings
f. Galvanized and black pipe
g. Metal stock

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 9

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given proper tools, equipment and various specifications, the student will thread two pieces of pipe and connect them with a coupling. The student will drill and tap a piece of metal stock. All work must meet industry standards and specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to drill correct hole size, to tap internal threads and to prepare external threads for pipe and standard bolt sizes.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-07 Identifying types of pipe and tube fittings used in refrigeration systems

PERFORMANCE STATEMENT

Identify types of pipe and tube fittings used in refrigeration systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Flare fittings
b. Sweat fittings
c. Quick couplings
d. Compression fittings
e. Types of tubing
f. Types of pipe

Provide Demonstration On:

Various types of fittings and pipe materials

Provide Practical Application On:

Identifying various types of fittings and pipe materials

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

Georgia, Refrigeration, Unit REF-07

Tools and Equipment:

a. Flare fittings
b. Sweat fittings
c. Compression fittings
d. Tubing (copper)
e. Pipe (pvc)

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a list of terms and materials used in fitting operations, the student will match each term and material with its use in fitting operations with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding types of pipe and tube fittings used in refrigeration systems.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-08 Performing basic copper tubing operations

PERFORMANCE STATEMENT

Perform basic copper tubing operations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Selecting proper tools for flaring, swaging, cutting and bending copper tubing
b. Proper method of preparing copper tubing for joining together
c. Selecting proper tools for flaring copper tubing

Provide Demonstration On:

a. Cutting, swaging and bending copper tubing
b. Flaring copper tubing
c. Fitting together copper tubing

Provide Practical Application On:

a. Cutting tubing
b. Flaring copper tubing
c. Bending copper tubing
d. Swaging copper tubing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Basic Copper Tubing Operations" (ST)

Student Manuals:

Georgia, Refrigeration, Unit REF-08

Tools and Equipment:

a. Swaging tools
b. Flaring tools
c. Bending tools
d. Tubing cutters
e. Copper tubing

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 4

Performance Objective (CRM)

Given soft copper tubing and other proper materials and equipment, the student will make flared fittings and swaged joints and will bend with proper accuracy a 90° angle.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to perform basic copper tubing operations. Students' performance must meet industry standards and specifications.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-09 Swaging, cleaning, fluxing and soft soldering copper tubing

PERFORMANCE STATEMENT

Swag, clean, flux and soft solder copper tubing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Joining copper tubing
c. Lighting the torch
d. Applying flux
e. Applying solder
f. Cleaning joints before soldering
g. Different types of solder
h. Capillary attraction
i. Procedures for brazing and soldering
j. Advantages of tin silver soldering

Provide Demonstration On:

a. Proper, flame while soldering
b. Applying solder correctly
c. Soldering air tight joints
d. Soldering uniform joints

Provide Practical Application On:

Soldering copper tubing with various types of solder until joints are uniform and air tight

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Soft Soldering Copper Tubing" (ST)

Student Manuals:

Georgia, Refrigeration, Unit REF-09

Tools and Equipment:

a. Tools
b. Torch
c. Gloves
d. Pliers
e. 50-50, 95-5 and silver solder
f. Soldering paste and flux
g. Copper tubing

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given copper tubing and other proper materials and equipment, the student will prepare and solder two joints together. The joints must be air tight, uniform in appearance and meet industry standards.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their ability to perform copper tubing operations. Students' performance must meet industry standards and specifications.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-10 Silver brazing refrigeration piping

PERFORMANCE STATEMENT

Silver braze refrigeration piping.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of silver brazing
b. Oxyacetylene equipment
c. Type of flame
d. Torch angles for various jobs
e. Flow point of silver solder
f. Type and use of flux
g. Oil and oxygen mixture
h. Comparison chart and specification table for major competitive alloys
i. Brazing while tubing is under pressure
j. Ventilation
k. Safety
l. Preparing tubing to be brazed

Provide Demonstration On:

a. Soldering technique with silver solder
b. Applying solder and flux
c. Flame control
d. Proper joints being uniform and free of leaks

Provide Practical Application On:

a. Cutting, shaping and joining copper tubing
b. Silver brazing copper tubing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Silver Brazing" (ST)

Student Manuals:

Georgia, Refrigeration, Unit REF-10

Tools and Equipment:

a. Oxyacetylene torch
b. Silver solder
c. Flux
d. Lighter
e. Copper tubing
f. Tools

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given oxyacetylene equipment and proper materials, the student will prepare and silver braze leak proof joints with copper tubing.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to perform silver brazing operations.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-11 Handling, transforming, weighing and measuring refrigerants

PERFORMANCE STATEMENT

Handle, transform, weigh and measure refrigerants.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Refrigerant groups
b. Characteristics of each group
c. Safety precautions
d. Measuring refrigerants
e. Weighing refrigerants
f. Transferring refrigerants from one container to another

Provide Demonstration On:

Handling, transferring, weighing and measuring each refrigerant group

Provide Practical Application On:

a. Checking the pressure on freon drums and recording the data
b. Determining type of freon from drum pressures
c. Transferring refrigerant from full to empty drums

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Handling Refrigerants" (ST)

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, Refrigeration, Unit REF-11

Tools and Equipment:

a. Gauge set
b. Thermometer
c. Temperature and pressure chart
d. Empty and full cylinder

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given various refrigerants, containers and other equipment and materials, the student will safely transfer refrigerant from one container to another, check the pressure on tanks of gas and fill out data sheets properly.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of handling, transferring, weighing and measuring refrigerants and the safety precautions involved when dealing with refrigerants.

b. Students should be given a performance test to assess their ability to handle, transfer, weigh and measure refrigerants safely.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Distinguish between fact and opinion
b. Recognize main ideas, details, sequence of events and cause and effect relationships
c. Follow directions
d. Make predictions, generalizations and comparisons
e. Draw conclusions
f. Interpret graphic information
g. Interpret instructions
h. Recognize relevance of data
i. Recognize appropriate reference resources
j. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion
e. Squares and square roots

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-12 Installing and using access valves

PERFORMANCE STATEMENT

Install and use access valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of access and service valves
b. Stem valves
c. Two way line valves
d. Tap on service valve
e. Schrader valves
f. Straddle valve
g. Piercing valves
h. Core type access valves
i. Line tap valves
j. Service valves or access valves
k. Applications for each type
l. Installing access valves
m. Cracking a valve
n. Process tube
o. Soldering the access service valve
p. Sight glass

Provide Demonstration On:

a. The function of the "stem type" service valve while installing and removing gauge lines
b. Method of installing the access valve

Provide Practical Application On:

a. Gaining entrance to the refrigeration system through a "stem type" service valve
b. Installing a soldered on Schrader type service valve

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Using Access Valves " (ST)

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, Refrigeration, Unit REF-12

Tools and Equipment:

a. Refrigeration systems
b. Access valves
c. Torch, solder and flux
d. Safety glasses
e. Gauge set
f. Leak detector

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given proper equipment and materials, the student will gain entrance to the refrigeration system through a stem type service valve and will install a Schrader type service valve with no leaks.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to gain entrance into a refrigeration system and install an access valve(s).

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-13 Maintaining refrigeration manifold gauges

PERFORMANCE STATEMENT

Maintain refrigeration manifold gauges.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. High pressure gauge
b. Compound gauge
c. Function of the gauge
d. Zero PSIG setting
e. Reading the pressure/temperature chart

Provide Demonstration On:

a. Reading gauges
b. Setting gauges at zero PSIG
c. Installing gauges

Provide Practical Application On:

a. Reading a series of gauges and recording data
b. Servicing valve inspection

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Maintaining Refrigeration Manifold Gauges" (ST)

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, Refrigeration, Unit REF-13

Tools and Equipment:

a. Manifold and gauges
b. Freon
c. Safety glasses
d. Pressure and temperature chart

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given proper equipment and materials, the student will correctly calibrate and read a high pressure and compound gauge with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to maintain various refrigeration manifold gauges.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-14 Installing and using refrigeration manifold gauges

PERFORMANCE STATEMENT

Install and use refrigeration mainfold gauges.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of manifold and gauge set
b. Installing manifold gauge
c. Purging
d. Positioning of service valve system
e. Checking pressure drops
f. Safety hazards

Provide Demonstration On:

a. Installing and removing gauges and hoses
b. Reading gauges

Provide Practical Application On:

Installing and removing gauges on a refrigeration system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Installing and Using Refrigeration Manifold Gauges" (ST)

Student Manuals:

a. Copeland Refrigeration Manuals
b. Georgia, Refrigeration, Unit REF-14

Tools and Equipment:

a. Gauge and manifold set
b. Refrigeration system
c. Freon
d. Safety glasses
e. Assorted tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given proper tools and equipment, the student will install gauges on an operating system and measure system pressure with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding the installation and usage of refrigeration manifold gauges.

b. Students should be given a performance test to assess their ability to install and use refrigeration manifold gauges.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interprets non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-15 Evacuating a refrigeration system

PERFORMANCE STATEMENT

Evacuate a refrigeration system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Absolute pressure
b. Noncondensables
c. Low vacuum
d. High vacuum
e. Micron
f. Evacuation
g. Vacuum
h. Single state pump
i. Two state pump
j. Mercury monometer
k. Vacuum pump oil
l. Reasons for evacuating a refrigeration system
m. Effects of moisture on a refrigeration system
n. Effects of air in a refrigeration system
o. Ambient temperature
p. Types of vacuum indicators
q. Pressure measurement
r. Inches of mercury measurement
s. Acid
t. Gauges

Provide Demonstration On:

Procedures for evacuating a refrigeration system

Provide Practical Application On:

Evacuating a refrigeration system until all moisture and air are eliminated from the system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Using a Vacuum Pump" (ST)

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-15

Tools and Equipment:

a. Refrigeration system
b. Two stage vacuum pump
c. Manifold and gauge set
d. Freon
e. Assorted tools

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigeration unit and proper equipment, the student will perform a multiple evacuation procedure and a deep vacuum procedure which meets industry standards and specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use a vacuum pump to evacuate a refrigeration system.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills

a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Metric conversion
g. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-16 Installing refrigeration accessories

PERFORMANCE STATEMENT

Install refrigeration accessories.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Absorb/adsorb
b. Back pressure regulators
c. Crankcase pressure regulators
d. Desiccant
e. Drier
f. Liquid line valve
g. Liquid indicator
h. Liquid line filter drier
i. Moisture indicator
j. Pump down valve
k. Receiver
l. Suction line accumulator
m. Suction line filter-drier
n. Vibration eliminator
o. Function of accessories
p. Installation of accessories

Provide Demonstration On:

Correct procedures for removing and replacing all components of the refrigeration system

Provide Practical Application On:

a. Installing a liquid indicator with flare-fittings
b. Installing a filter-drier with sweat fittings
c. Installing a capillary tube into a filter-drier
d. Pumping the system down
e. Testing leaks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Installing Refrigeration Accessories" (ST)

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-16

Tools and Equipment:

a. Refrigeration system
b. Flaring tools
c. Assorted hand tools
d. Torch
e. Refrigeration system components
f. Gauge and manifold set
g. Leak detector
h. Safety glasses

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 7

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigeration unit and accessories and proper tools, the student will remove and replace various accessories without any leaks.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install various refrigeration accessories.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversions

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-17 Testing for leaks

PERFORMANCE STATEMENT

Test for leaks.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods used in leak detection
b. Pressurizing the system
    1. Freon
    2. Dry nitrogen
c. Devices used in detecting leaks
d. Effect of leaks on the vacuum
e. Repairing leaks

Provide Demonstration On:

a. Testing for leaks using various methods
b. Repairing leaks

Provide Practical Application On:

Testing leaks with various leak testing devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Testing for Leaks" (ST)

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-17

Tools and Equipment:

a. Refrigeration system
b. Freon and dry nitrogen
c. Leak detectors
d. Gauges and manifold set
e. Assorted hand tools
f. Safety glasses

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the proper equipment and tools, the student will test for leaks with 100% accuracy using the "soap bubble" method, a halide torch and an electronic detector.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use various methods to test for leaks.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communication
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-18 Charging a refrigeration system

PERFORMANCE STATEMENT

Charge a refrigeration system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Handling refrigerants
b. Nameplate data
c. Charging methods
    1. Sight glass method
    2. Frost back method
    3. Vapor charging
    4. Liquid charging
    5. Weighin method
    6. Ambient temperature method
    7. Super heat method
d. Manufacturer's charts for charging procedures
e. Capillary and T.E.V. systems

Provide Demonstration On:

Various charging methods

Provide Practical Application On:

Charging the refrigeration system (Capillary and T.E.V. systems)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Charging the System" (ST)

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-18

Tools and Equipment:

a. Refrigeration systems
b. Manifold and gauge set
c. Freon
d. Thermometer
e. Assorted hand tools
f. P.R. chart
g. Safety glasses

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given proper equipment and materials, the student will charge a refrigeration system using the vapor method, the liquid method and the ambient temperature method with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to charge a refrigeration system using various methods.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills

a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Metric conversion
f. Squares and square roots

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-19 Troubleshooting refrigerator compressors

PERFORMANCE STATEMENT

Troubleshoot refrigerator compressors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. A reciprocal compressor
b. Rotary compressor
c. Centrifugal compressor
d. Screw type compressor
e. Hermetic compressor
f. Semi-hermetic compressor
g. Open type compressor
h. Testing the compressor
i. Diagnosing problems in compressors

Provide Demonstration On:

a. Compressor types
b. Troubleshooting and replacement procedures

Provide Practical Application On:

Diagnosing problems and repairing various compressors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Testing the Compressor" ST)

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-19

Tools and Equipment:

a. Compressors
b. Electric meters
c. Manifold and gauge set
d. Assorted hand tools
e. Refrigerant
f. Safety glasses

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a semi-hermetic and hermetic compressor and proper tools, the student will diagnose problems in the compressors and will remove and replace the faulty compressors with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot various types of refrigerator compressors.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-20 Troubleshooting condensers

PERFORMANCE STATEMENT

Troubleshoot condensers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air cooled condenser (natural draft)
b. Air cooled condenser (forced draft)
c. Air cooled condenser (forced air, remote)
d. Water cooled condenser (shell and tube)
e. Water cooled condenser (tube within a tube)
f. Water cooled condenser (evaporative)
g. Piping layouts
h. Diagnosing condenser problems

Provide Demonstration On:

a. Various types of condensers
b. Troubleshooting techniques
c. Replacement procedures

Provide Practical Application On:

a. Troubleshooting problems in various types of condensers
b. Removal and replacement of condensers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-20

Tools and Equipment:

a. Various types of condensers
b. Assorted tools
c. Test instruments

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

Performance Objective (CRM)

Given various types of condensers, tools and test equipment, the student will diagnose and correct faulty operation in the condensers and will remove and replace faulty condensers with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot various types of condensers.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communication
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-21 Troubleshooting evaporators

PERFORMANCE STATEMENT

Troubleshoot evaporators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of evaporators
b. Fin type evaporators
c. Flooded type evaporators
d. Diagnosing malfunctions
e. Removal and replacement procedures

Provide Demonstration On:

a. Types of evaporators
b. Troubleshooting techniques
c. Replacement procedures

Provide Practical Application On:

a. Troubleshooting problems in various types of evaporators
b. Removing and replacing evaporators

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration Unit REF-21

Tools and Equipment:

a. Refrigeration systems
b. Manifold and gauge set
c. Freon
d. Leak detector
e. Torch and solder
f. Assorted tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given various types of evaporators, proper tools and equipment, the student will diagnose and correct faulty operation and will repair or remove and replace faulty evaporators with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot various types of evaporators.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipluation

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

RF-22 Troubleshooting an automatic expansion valve

PERFORMANCE STATEMENT

Troubleshoot an automatic expansion valve.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of the valve
b. Improper adjustment
c. Moisture in the valve
d. Moisture in the bellows of diaphragm
e. Components of the valve
f. Diagnostic techniques
g. Adjustment procedures
h. Replacement procedures

Provide Demonstration On:

a. Diagnostic techniques
b. Adjustment procedures

Provide Practical Application On:

a. Disassembling, inspecting and reassembling the automatic expansion valve
b. Removing, replacing and adjusting the automatic expansion valve

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-22

Tools and Equipment:

a. Automatic expansion valves
b. Refrigeration system with the automatic expansion valve
c. Manifold and gauge set
d. Assorted hand tools
e. Freon

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigeration system with a faulty automatic expansion valve, the student will diagnose faulty operation in the valve and will repair or remove and replace the valve with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot an automatic expansion valve.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-23 Troubleshooting capillary tubes

PERFORMANCE STATEMENT

Troubleshoot capillary tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of the capillary system
b. Capillary tube applications
c. Diagnosing faulty operation
d. Removal and replacement procedures
e. Sizing the tube system
f. Type of motors used on the capillary system
g. Correct freon charge

Provide Demonstration On:

a. Properly and improperly functioning capillary systems
b. Removal and replacement procedures

Provide Practical Application On:

a. Diagnosing faulty capillary system
b. Using a operation hydraulic tester
c. Removing and replacing capillary tube systems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-23

Tools and Equipment:

a. Capillary
b. Manifold and gauge set
c. Torch and solder
d. Freon
e. Drier
f. Assorted hand tools

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigeration system with faulty functioning of the capillary tubes, the student will diagnose the malfunction and will repair or remove and replace the capillary system with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot capillary tubes.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Law of exponents
b. Logarithms
c. Ratios, proportions and percents
d. Fractions and decimals usage and conversions
e. Whole number manipulation
f. Metric conversion
g. Squares and square roots

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-24 Troubleshooting thermostatic expansion valves

PERFORMANCE STATEMENT

Troubleshoot thermostatic expansion valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of thermostatic expansion valves
b. Location
c. Functioning
d. Sub-cooling
e. Component parts
f. Bulb location and installation
g. External equalizer connection
h. Driers, strainers and accessories
i. Test pressures and dehydration temperatures
j. Determining super heat
k. Malfunctions
l. Repairing the valve
m. Valve setting
n. Evaporating temperature
o. Thermostatic charge
p. Internal and external equalizer
q. Pumping down the thermostatic expansion valve system

Provide Demonstration On:

a. Types of thermostatic expansion valves
b. Diagnostic techniques
c. Repair and replacement procedures

Provide Practical Application On:

a. Diagnosing faulty thermostatic expansion valve functioning
b. Repair and adjust procedures
c. Removal and replacement procedures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting a Thermostatic Expansion Valve" (ST)

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-24

Tools and Equipment:

a. Thermostatic expansion valve refrigerator system
b. Assorted thermostatic expansion valves
c. Manifold and gauge set
d. Freon
e. Drier
f. Assorted tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

Performance Objective (CRM)

Given a refrigeration system with faulty functioning of the thermostatic expansion valve, the student will diagnose the malfunction and will repair or remove and replace the thermostatic expansion valve with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot thermostatic expansion valves.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Law of exponents
b. Logarithms
c. Trigonometry, right angles, sine, cosine, and tangent
d. Fractions and decimals usage and conversions
e. Whole number manipulation
f. Metric conversion
g. Squares and square roots

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-25 Troubleshooting the refrigeration system

PERFORMANCE STATEMENT

Troubleshoot the refrigeration system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Troubleshooting from symptoms
b. Types of compressor failure
c. Types of condenser failure
d. Types of evaporator failure
e. Refrigerant leaks
f. Capillary tube failure
g. Low charge and high charge
h. Non-condensables
i. Automatic expansion valve failure
j. Thermostatic expansion valve failure
k. Troubleshooting tables

Provide Demonstration On:

Troubleshooting techniques

Provide Practical Application On:

Diagnosing and repairing various problems in refrigeration systems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Refrigeration
c. Prentice-Hall, Refrigeration and Air Conditioning

Student Manuals:

a. Carrier, GTR Manuals
b. Copeland Refrigeration Manuals
c. Georgia, Refrigeration, Unit REF-25

Tools and Equipment:

a. Refrigerator systems
b. Manifold and gauge set
c. Freon
d. Test meters
e. Leak detector
f. Assorted tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigeration system having malfunctions, the student will diagnose and repair the malfunctions so that the system is fully operational.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot malfunctioning refrigeration systems with 100% accuracy.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognzie main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-26 Installing a window air conditioning unit

PERFORMANCE STATEMENT

Install a window air conditioning unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air conditioning parts
b. Window parts
c. Tools to be used
d. Installation checkpoints
    1. Adequate wiring and fuses
    2. Drainage slope
    3. Secure placement
    4. Window lock
    5. Air leaks
    6. Filter
    7. Correct operation of unit
e. Annual maintenance

Provide Demonstration On:

Correct installation procedures

Provide Practical Application On:

Installing a window air conditioner in a mock-up window

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Installation of a Window Unit" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-06; Refrigeration, Unit REF-26

Tools and Equipment:

a. Assorted hand tools
b. Permagum
c. Safety-glasses
d. Window air conditioner
e. Mock-up window

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a window air conditioning unit and assorted tools, the student will install the unit in a window according to manufacturer's specifications and according to standard practice.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a window air conditioning unit which meets manufacturer's specifications and standards.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-27 Performing pre-season start-up maintenance on window air conditioning units

PERFORMANCE STATEMENT

Perform pre-season start-up maintenance on window air conditioning units.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. When and why to perform pre-season start-up maintenance
b. Typical problems
   1. Rotten wood around window
   2. Cracks in seals and windows
   3. Water leaks
   4. Dirty filter
   5. Dirty coils
   6. Tilt of unit
   7. Condition of braces
   8. Condition of receptacle and cord
c. Maintenance steps
   1. Remove unit
   2. Oil fan motor
   3. Wrap fan motor in plastic
   4. Clean coils
   5. Straighten fins
   6. Clean evaporator drains
   7. Repair bracing
   8. Tilt unit properly
   9. Repair rotten wood

(Continued on back)

Provide Demonstration On:

Routine procedures and special problems

Provide Practical Application On:

Perfoming a pre-season start-up maintenance on a window unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Performing Pre-Season Start-Up" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-07; Refrigeration, Unit REF-27

Tools and Equipment:

a. Assorted hand tools
b. Seals, filters, permagum
c. A window unit in need of pre-season maintenance

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

c. Maintenance steps
   10. Repair or replace damaged or missing seals
   11. Reinstall unit
   12. Clean filter
   13. Repair cord
   14. Repair receptacle
   15. Start-up and run
   16. Check inlet and outlet temperatures
   17. Repair water leaks
   18 Clean area
   19. Inform customer of maintenance procedures

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a window air conditioning unit in need of pre-season maintenance, the student will perform pre-season maintenance according to the steps in this unit.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to perform pre-season maintenance on a window air conditioning unit.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-28 Troubleshooting compressor burnout in window air conditioners

PERFORMANCE STATEMENT

Troubleshoot compressor burnout in window air conditioners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of burnout
b. Causes of burnout
c. Diagnosing burnout
d. Acidic oil
e. Replacing a burned out compressor
f. Bleeding the refrigerant
g. Removing and replacing drier or filter and capillary tubes
h. Flushing the evaporator and condenser
i. Evacuating the system
j. Charging the system

Provide Demonstration On:

a. Correct use of test instruments
b. Changing out compressors
c. Evacuating and charging the system

Provide Practical Application On:

a. Diagnosing different types of burnout
b. Replacement of a burned out compressor in a window unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting Compressor Burnout in a Window Air Conditioner" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-08; Refrigeration Unit REF-28

Tools and Equipment:

a. Burned out and functional compressors
b. VOM, amprobe
c. Vacuum pump
d. Freon
e. Assorted hand tools
f. Compressor test cord
g. Capillary tubes
h. Filter/drier

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a window air conditioner with a burned out compressor, the student will diagnose the nature of the burnout and will replace it with a functional compressor. Replacement will include flushing, evacuation and recharging the system. The student must troubleshoot the burned out compressor with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot compressor burnout in a window air conditioning unit.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-29 Evacuating and charging window air conditioners

PERFORMANCE STATEMENT

Evacuate and charge window air conditioners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. When evacuating and charging are performed
b. Removing all the freon
c. Evacuating the system to 500 microns
d. Breaking the vacuum to zero PSIG with freon vapor
e. Charging the system by the coil temperature and Dial-a-charge methods
f. Checking the system for peak performance
g. Possible safety hazards

Provide Demonstration On:

a. Use of the vacuum pump
b. Charging the system with freon
c. Recognizing when a system is fully charged

Provide Practical Application On:

Evacuating and charging a window unit using the temperature, pressure and touch method and the Dial-a-charge method

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Evacuating and Charging a Window Air Conditioner" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-09; Refrigeration, Unit REF-29

Tools and Equipment:

a. A window air conditioner to be evacuated and charged
b. Vacuum pump and gauges
c. Freon
d. Thermometers
e. Drier
f. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a window air conditioner unit, freon, vacuum pump, gauges and the proper tools, the student will evacuate and recharge the system using both the temperature, pressure and touch method and the Dial-a-charge method so that the system operates at peak efficiency.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to evaluate and charge a window air conditioning unit.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Organize data into graphics
i. Interpret graphic data
j. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-30 Troubleshooting fans and fan motors

PERFORMANCE STATEMENT

Troubleshoot fans and fan motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of shaded-pole and PSC motors
b. Reading motor schematics
c. Types of mechanical failure
d. Types of electrical failure
e. Operational symptoms of failure
f. Testing for shorts, opens and grounds using the VOM
g. Using the "direct test" method
h. Removing and replacing faulty motors

Provide Demonstration On:

a. Examples of mechanical and electrical failure in fans and motors
b. Testing with the VOM
c. "Direct test" method

Provide Practical Application On:

a. Using the VOM to diagnose electrical failure in defective fan motors
b. Using the "direct test" to diagnose electrical failure in defective motors
c. Removing and replacing a fan and motor in a window unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting Fans and Fan Motors" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-10; Refrigeration, Unit REF-30

Tools and Equipment:

a. Fan motors with various defects
b. Window air conditioner unit
c. Replacement fan motor
d. Direct test leads
e. VOM, amprobe
f. Assorted hand tools

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a window air conditioning unit with a faulty fan motor, the student will diagnose the nature of the fault and will remove and replace the fan motor so that the unit operates properly.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot fans and fan motors.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion
Problem Solving
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communication
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-31 Troubleshooting mechanical problems in a window air conditioner refrigeration cycle

PERFORMANCE STATEMENT

Troubleshoot mechanical problems in a window air conditioner refrigeration unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The most common problems
b. External indicators
   1. Dirty evaporator or condenser
   2. Air temperature drop across evaporator
   3. Evaporator temperature
   4. Suction line temperature
   5. Discharge line temperature
   6. Condenser liquid line temperature
   7. Capillary tube temperature
c. Entering the system
   1. Type of service valve
   2. Discharge pressure
   3. Suction pressure
d. Using the refrigeration cycle charts

Provide Demonstration On:

a. Indicators of proper functioning
b. Entering the refrigeration system
c. Proper use of test instruments

Provide Practical Application On:

Diagnosing and repairing a window air conditioner with a mechanical problem in the refrigeration cycle

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting Window Air Conditioner Refrigeration Cycle" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-11; Refrigeration, Unit REF-31

Tools and Equipment:

a. Window air conditioner with refrigeration fault
b. Replacement parts, Shrader valves
c. Freon and gauges
d. Thermometers
e. Torch
f. Air and brushes for cleaning
g. Assorted tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given the proper test instruments, repair equipment and a window air conditioning unit with a faulty mechanical refrigeration cycle, the student will accurately diagnose and repair the problem so that the unit operates at peak capacity.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot mechanical problems in a window air conditioning refrigeration cycle.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills
a. Intepret aural communications
b. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-32 Troubleshooting a window air conditioner electrical system

PERFORMANCE STATEMENT

Troubleshoot a window air conditioner electrical system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Identifying all electrical components
b. Reading wiring diagrams
c. Testing components with the VOM and amprobe
    1. Fan motor
    2. Compressor
    3. Mainswitch
    4. Thermostat
    5. Overload
    6. Capacitors
d. Checking line voltage
e. Checking receptable and wiring
f. Checking fuses

Provide Demonstration On:

Testing with the amprobe and VOM

Provide Practical Application On:

Diagnosing electrical problems in window air conditioner units

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano. Modern Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting a Window Air Conditioning Electrical System" (ST)

Student Manuals:

Georgia, Air Conditioning, Unit AC-12; Refrigeration, Unit RF-32

Tools and Equipment:

a. Window air conditioning units with electrical faults
b. VOM
c. Assorted tools
d. Amprobe

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

Performance Objective (CRM)

Given a number of window air conditioners with various electrical problems, the student will diangose the nature of each problem with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot a window air conditioner electrical system.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-33 Identifying and describing the function of refrigeration components

PERFORMANCE STATEMENT

Identify and describe the function of refrigeration components.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor (reciprocal and rotary)
b. Oil-cooler
c. Discharge line
d. Condenser (forced air and static)
e. Liquid line
f. Filter-drier
g. Metering device
h. Evaporator (shell, fin, shelf)
i. Suction line
j. Freezers (chest and upright)
k. Refrigerators

Provide Demonstration On:

a. Identifying components on refrigerators and freezers
b. Describing the function of each component

Provide Practical Application On:

a. Locating the components on a refrigerator and a freezer
b. Writing a brief description of each component

INSTRUCTIONAL MATERIALS

Textbooks:

Prentice-Hall, Refrigeration and Air Conditioning

Georgia, "Understanding Basic Operation" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-33
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. All basic refrigeration components
b. Refrigeration cut-a-way
c. Charts and diagrams of system

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer, the student will identify all refrigeration components and write a short description explaining the function of each with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding the function of all refrigeration components.

b. Students should be given a performance test to assess their ability to identify all refrigeration components.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-34 Evacuating and charging domestic refrigerator and freezer systems

PERFORMANCE STATEMENT

Evacuate and charge domestic refrigerator and freezer systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Installing access valves (styles and types)
b. Triple evacuation
c. Deep evacuation
d. Purpose of evacuation
e. Safety while handling refrigerants
f. Charging with liquid
g. Charging with vapor
h. Sealing the system
i. Testing for leaks

Provide Demonstration On:

Going through complete evacuation and charging procedures on a refrigerator or freezer

Provide Practical Application On:

Evacuating and charging a refrigerator or freezer by liquid and vapor methods

INSTRUCTIONAL MATERIALS

Textbooks:

Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Evacuating and Charging Refrigerators and Freezers" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-34
b. MAVCC, Air Conditioning and Refrigeration, Book One

Tools and Equipment:

a. Access valves
b. Refrigerator system
c. Vacuum pump
d. Manifold gauge
e. Refrigerant
f. Safety glasses
g. High vacuum gauge
h. Leak detector (electronic and halide torch)
i. Soap
j. Pinch off tool and soldering equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer and necessary tools and equipment, the student will evacuate, charge and leak test the system. The amount of refrigerant and depty of evacuation must be within manufacturer's specifications. All leaks, if any, must be detected.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to evacuate, charge and leak test refrigerator and freezer systems.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-35 Testing and replacing defective refrigeration cycle components

PERFORMANCE STATEMENT

Test and replace defective refrigeration cycle components.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Frost patterns
b. Restrictions
c. Low refrigerant (leaks)
d. Recording temperatures
e. High pressures
f. Low pressures
g. Air leaks (door gasket)
h. Moisture contamination
i. Thermostat problems

Provide Demonstration On:

Locating a known problem in a refrigerator/freezer refrigeration cycle

Provide Practical Application On:

Locating the cause of a refrigeration failure on an operable refrigerator/freezer with known condition

INSTRUCTIONAL MATERIALS

Textbooks:

Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting Refrigeration Cycle" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-35
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. Refrigerator with known problem
b. Manifold gauges
c. Leak detection equipment
d. VOM
e. Troubleshooting chart
f. Shop manual

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

Performance Objective (CRM)

Given a refrigerator or freezer and necessary tools and equipment, the student will test and replace defective refrigeration cycle components with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test and replace defective refrigeration cycle components.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-36 Troubleshooting refrigerator/freezer compressor burnout

PERFORMANCE STATEMENT

Troubleshoot refrigerator/freezer compressor burnout.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Excessive heat loads
b. Runs excessively hot
c. Short cycle
d. Low voltage
e. High voltage
f. Mechanical failures
g. Resistance readings on common, start and run terminals

Provide Demonstration On:

Checking the compressor with a VOM

Provide Practical Application On:

Determining the condition of a failed compressor and describe probable cause of failure

INSTRUCTIONAL MATERIALS

Textbooks:

Doolin, Doolin's Troubleshooter's Bible

A/Vs:

Georgia, "Troubleshooting Compressor Burnout" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-37
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. Different styles of compressors
b. Start-run cord
c. VOM
d. Troubleshooting chart
e. Shop manual

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer with a defective compressor and necessary tools and equipment, the student will determine if the compressor is serviceable and if not, what caused the burnout. All resistance readings must be within 10% of know conditions and the cause of burnout must be stated accurately.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot refrigerator/freezer compressor burnout.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills
a. Interpret aural communications
b. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-37 Testing and repairing/replacing refrigerator/freezer fans and fan motors

PERFORMANCE STATEMENT

Test and repair/replace refrigerator/freezer fans and fan motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of evaporator fan motor
b. Function of condenser fan motor
c. Restricted or no air switch
d. Checking motor and switch
e. Wiring schematics

Provide Demonstration On:

a. Checking fan motors and switches
b. Interpreting wiring schematics

Provide Practical Application On:

a. Checking out condenser and evaporator fan motors
b. Cleaning or replacing motor switches
c. Checking and replacing motor switches

INSTRUCTIONAL MATERIALS

Textbooks:

Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning

A/Vs:

Georgia, "Troubleshooting Fans and Fan Motors" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-36
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. Refrigerator with wiring schematic attached to back
b. VOM
c. Shop manual

ESTIMATED CLASS HOURS 1

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer and necessary tools and equipment, the student will test all fan motors, determine the condition and replace as necessary. Faulty fan motors must be identified and replaced according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test and repair/replace refrigerator/freezer fans and fan motors.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions

TASK OR UNIT COMPETENCY

RF-38 Diagnosing problems in refrigerators and freezers

PERFORMANCE STATEMENT

Diagnose problems in refrigerators and freezers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Developing and reading troubleshooting charts
b. Reading wiring diagrams
c. Reviewing refrigeration cycle
d. Testing perimeter
e. Testing switches
f. Defrost timer
g. Temperature control
h. Using touch, sight and hearing to locate problems

Provide Demonstration On:

Developing a comprehensive troubleshooting plan

Provide Practical Application On:

Developing a comprehensive troubleshooting plan and applying it to several refrigerator/freezer systems

INSTRUCTIONAL MATERIALS

Textbooks:

Doolin, Doolin's Troubleshooter's Bible

Student Manuals:

a. Georgia, Refrigeration, Unit REF-38
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. Refrigerator
b. Troubleshooting charts
c. Diagnostic tools
d. Shop manual

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer with an unknown malfunction and necessary tools and equipment, the student will develop a troubleshooting plan leading to the cause of the failure. The student will recommend needed repairs. The student's recommendation must be the same as the instructor's.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their ability to develop a troubleshooting plan for a defective refrigerator or freezer.

b. Students should be given a performance test to assess their ability to troubleshoot a defective refrigerator or freeser.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Interpret graphic data
i. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions

TASK OR UNIT COMPETENCY

MA-01 Developing a troubleshooting plan for a major appliance

PERFORMANCE STATEMENT

Develop a troubleshooting plan for a major appliance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Developing and reading troubleshooting charts
b. Reading wiring diagrams
c. Using touch, sight and hearing to locate problems
d. Microprocessors used in major appliances
    1. Removal procedures
    2. Replacement procedures

Provide Demonstration On:

Developing a comprehensive troubleshooting plan

Provide Practical Application On:

Developing a comprehensive troubleshooting plan and applying it to several major appliances

INSTRUCTIONAL MATERIALS

Textbooks:

a. Doolin, Doolin's Troubleshooter's Bible
b. Manufacturer's manual

Tools and Equipment:

a. Major appliances
b. Troubleshooting charts
c. Diagnostic tools
d. Manufacturer's test equipment

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a major appliance with an unknown malfunction and necessary tools and equipment, the student will develop a troubleshooting plan leading to the cause of the failure. The student will recommend needed repairs. The student's recommendation must be the same as the instructor's.

Suggested Testing Activities And Resources

a. Students should be given a written or performance test to assess their ability to develop a troubleshooting plan for the following major appliances: electric clothes dryer; gas clothes dryer; dishwasher; microwave oven; cook top and vent; clothes washer; trash compactor; refrigerator and/or freezer; gas stove; gas water heater; electric water heater; electric water heater; electric ovens; and gas ovens.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Recognize appropriate reference resources
e. Locate information in reference materials

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Make predictions, generalizations and comparisons

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-02 Installing and wiring an electric clothes dryer

PERFORMANCE STATEMENT

Install and wire an electric clothes dryer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electrical Code (NEC)
f. Installation procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Using the NEC to determine requirements
b. Making wiring connections
c. Typical installations
d. Using a multimeter and ampmeter
e. Proper venting method

Provide Practical Application On:

a. Determining size and type of wire, number of conductors and amperage rating of receptacle for a given dryer
b. Installing and wiring the dryer
c. Installing a pigrail
d. Making operational checks
e. Using a multimeter and an ampmeter to install a dryer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Alerich, Electrical Construction Wiring
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2
c. Mullin, Electrical Wiring - Residential

A/Vs:

AAVIM "Electrical Wiring" (ST)

Student Manuals:

a. AAVIM, Electrical Wiring, Unit 305SW
b. Georgia, Major Appliances, Unit MA-04

Tools and Equipment:

a. Shop tools
b. Wire and receptacles
c. Dryer
d. NEC manual
e. Local codes
f. Multimeter and ampmeter

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electric clothes dryer and necessary tools and equipment, the students will install and wire the dryer in accordance with the National Electric Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors, and amperage rating of receptacle for a given type of electric clothes dryer.

b. Students should perform an operational check of the clothes dryer.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 2

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Make predictions, generalizations and comparisons
b. Draw conclusions
c. Recognize appropriate reference resources
d. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal or informal speaking styles

TASK OR UNIT COMPETENCY

MA-03 Troubleshooting and servicing electric dryer mechanical/ electrical systems

PERFORMANCE STATEMENT

Troubleshoot and service electric clothes dryer mechanical/electrical systems.

INSTRUCTIONAL ACTIVITIES

Prerequisite Task:

MA-01

Provide Information On:

a. Motors
b. Timers
c. Thermostats
d. Heating element
e. Door switch
f. Belts
g. Drums
h. Air leaks
i. Testing and inspecting for serviceability
j. Proper venting method

Provide Demonstration On:

a. Testing motor
b. Testing thermostat
c. Testing element
d. Testing door switch
e. Testing belt and drum

Provide Practical Application On:

Testing, removing and replacing the motor, timer, thermostats, heating element, door switch, belt and drum

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

Georgia, "Servicing Dryer Electrical System" (ST)

Student Manuals:

Georgia, Major Appliances, Units MA-16, MA-17

Tools and Equipment:

a. Shop tools
b. VOM
c. Assortment of motors, switches, thermostats, elements and timers
d. Shop manual
e. Manufacturer's test equipment
f. Ampmeter

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic electric clothes dryer and necessary tools and equipment, the student will test and replace the motor, timer, thermostats, heating element, door switch, belt and drum. All work must conform to manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot the mechanical and electrical systems of an electric clothes dryer.

b. Students should be given a performance test to assess their ability to remove and replace defective components of the mechanical and electrical systems.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task Nos. 19, 20, 34 and 90

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Draw conclusions
c. Interpret graphic information
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials

Math Skills

a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Interpret graphic data

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

e. Recognize relevance of data
f. Interpret graphic data

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-04 Installing, plumbing and wiring a clothes washer

PERFORMANCE STATEMENT

Install, plumb and wire a clothes washer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Plumbing procedures
h. Tools required
i. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Determining size and type of wire, number of conductors and amperage rating of receptacle for a given clothes washer
b. Installing necessary plumbing
c. Installing wiring
d. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Mullin, Electrical Wiring - Residential
c. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

AAVIM, "Electrical Wiring,"(ST)

Student Manuals:

a. AAVIM, Electrical Wiring, Unit 305SW
b. Georgia, Major Appliances, Unit MA-05

Tools and Equipment:

a. Shop tools
b. Various wire sizes
c. Clothes washer
d. NEC manual
e. Local codes
f. Plumbing equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

Performance Objective (CRM)

Given a clothes washer and necessary tools and equipment, the student will determine correct wire specifications and install, wire and plumb the washer in accordance with the National Electric Code and local codes. No water leaks are allowed.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors and amperage rating of receptacle for a given type of clothes washer.

b. Students should perform an operational check of the washing machine.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 2

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Draw conclusions
b. Recognize appropriate reference resources
c. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Whole number manipulation
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Estimate outcomes
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-05 Troubleshooting and replacing the clothes washer water level control and door switches

PERFORMANCE STATEMENT

Troubleshoot the water level control and door switches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation and function of switches
b. Location of switches
c. Testing the switches
d. Interaction of times, switches and fill valve

Provide Demonstration On:

a. Testing and replacing water level control
b. Testing and replacing door switches

Provide Practical Application On:

Testing, removing and replacing the water level control and door switches

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

Georgia, "Electrical Systems Operation and Troubleshooting" (ST)

Student Manuals:

Georgia, Major Appliances, Unit MA-11

Tools and Equipment:

a. VOM
b. Hand tools
c. Washing machine
d. Various switches
e. Wiring schematic
f. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a clothes washer and necessary tools and equipment, the student will test, remove and replace the water level control and door switches. All work must be within manufacturer's specifications and the machine must perform as the manufacturer intended with no indication of water leakage

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to locate and describe different types of switches.

b. Students should be given a performance test to assess their ability to test, remove and replace a water level control switch.

c. Georgia, Electromechanical Instructor Guide-Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Recognize appropriate reference resources
c. Locate information in reference materials
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Estimate outcomes
d. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-06 Troubleshooting and replacing the clothes washer timer and solenoids

PERFORMANCE STATEMENT

Troubleshoot and replace the clothes washer timer and solenoids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation and function of timer and solenoids
b. Timer motor
c. Timer contacts
d. Testing the timer
e. Location of solenoids
f. Testing solenoids
g. Timer and solenoid interaction

Provide Demonstration On:

a. Testing and replacing clutch
b. Testing and replacing brake solenoids

Provide Practical Application On:

Removing and replacing the timer, fill valve and clutch or brake solenoids

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrial Appliances, Vol. 2

A/Vs:

Georgia, "Toal Washing Machine Operation" (ST); "Electrical Systems Operation and Troubleshooting" (ST)

Student Manuals:

Georgia, Major Appliances, Units MA-10, MA-11

Tools and Equipment:

a. VOM
b. Hand tools
c. Washing machine
d. Timer and solenoids
e. Wiring schematic
f. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 11

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a clothes washing machine and necessary tools and equipment, the student will test, remove and replace the timer, fill solenoid, clutch solenoid and brake solenoid. All work must be within manufacturer's specifications and the machine must perform as the manufacturer intended with no indication of water leakage.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the operation and function of the timer and selected types of solenoids.

b. Students should be given a performance test to assess their ability to troubleshoot and replace the timer and selected types of solenoids.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 45

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills

a. Scientific and engineering notation
b. Law of exponents
c. Ratios, proportions and percents
d. Fractions and decimals usage and conversions
e. Whole number manipulation
f. Algebra
g. Squares and square roots
h. Apply formulas
i. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications
e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-07 Troubleshooting and replacing the clothes washer motor and relay

PERFORMANCE STATEMENT

Troubleshoot and replace the clothes washer motor and relay.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation and function of relay
b. Purpose of relay
c. Interaction of timer, motor and relay
d. Motor classification
e. Testing the motor

Provide Demonstration On:

Testing and replacing the motor and relay

Provide Practical Application On:

Testing, removing and replacing the motor and relay

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's Manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

Georgia, "Electrical Systems Operation and Troubleshooting" (ST)

Student Manuals:

Georgia, Major Appliances, Unit MA-11

Tools and Equipment:

a. VOM meter
b. Hand tools
c. Washing machine
d. Motors and relays
e. Wiring schematic
f. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 12

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a clothes washer and necessary tools and equipment, the student will test, remove and replace the motor and relay. All work must be within manufacturer's specifications and the machine must perform as the manufacturer intended with no indication of water leakage.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of (1) the purpose and operation of the motor relay and (2) the interaction of the timer, motor and relay.

b. Students should perform an operational check of the replaced motor and relay.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task Nos. 27, 90

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Apply formulas
g. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

MA-08 Troubleshooting and replacing the clothes washer drain pump

PERFORMANCE STATEMENT

Troubleshoot and replace the clothes washer drain pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation and function of pump
b. Types of pumps
c. Pump seals
d. Testing the pump for proper operation

Provide Demonstration On:

Repairing pump

Provide Practical Application On:

Testing, removing and replacing the pump

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

Georgia, "Water Systems Operation and Troubleshooting" (ST)

Student Manuals:

Georgia, Major Appliances, Unit MA-15

Tools and Equipment:

a. VOM
b. Hand tools
c. Washing machine
d. Drain pumps
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 11

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a clothes washer and the necessary tools and equipment, the student will test, remove and replace the drain pump. All work must be within manufacturer's specifications and the machine must perform as the manufacturer intended with no indication of water leakage.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their ability to identify types of pumps.

b. Students should perform an operational check of the replaced drain pump.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Recognize appropriate reference resources
e. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Interpret graphic data
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret graphic data
Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

MA-09 Troubleshooting and replacing/repairing the clothes washer clutch and transmission

PERFORMANCE STATEMENT

Troubleshoot and replace/repair the clothes washer clutch and transmission.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation and function of clutch and transmission
b. Types and styles
c. Removing and replacing/repairing
d. Inspection

Provide Demonstration On:

a. Testing and replacing/repairing clutch
b. Testing and replacing/repairing transmission

Provide Practical Application On:

Testing, removing and replacing/repairing the clutch and transmission

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

Georgia, "Mechanical Systems Operation and Troubleshooting" (ST)

Student Manuals:

Georgia, Major Appliances, Unit MA-13

Tools and Equipment:

a. Special tools required by manufacturer
b. Hand tools
c. Washing machine
d. Clutches and transmissions
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 12

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a clothes washer and necessary tools and equipment, the student will test, remove and replace/repair the clutch and transmission. All work must perform as the manufacturer intended with no indication of water leakage.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the function and operation of a clothes washer clutch and transmission.

b. Students should be given a performance test to assess their ability to repair a clothes washer transmission.

c. Students should perform an operational check on the replaced/repaired clutch and transmission.

d. Georgia, Electromechanical Instructor Guide - Checkpoints Information

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret instructions
d. Recognize appropriate reference resources
e. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications
e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-10 Installing, wiring and plumbing an electric water heater

PERFORMANCE STATEMENT

Install, wire and plumb an electric water heater

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determing electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Tools required
h. Pressure vent
i. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installation
d. Proper water hook up

Provide Practical Application On:

a. Determing size and type of wire, number of conductors and amperage
b. Making the necessary water hook ups
c. Installing and wiring unit
d. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Mullin, Electrical Wiring-Residential
c. Ruel and Nolte, Servicing Electrical Appliances, Vol. 1

Student Manuals:

AAVIM, Electrical Wiring, Unit 305SW

Tools and Equipment:

a. Shop tools
b. Wire and receptacles
c. Water heater
d. NEC manual
e. Local codes
f. Copper pipe and soldering equipment (or PVC)

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electric water heater and necessary tools and equipment, the student will install, plumb and wire the heater in accordance with the National Electric Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors, and aperage rating of receptacle for a given type of electric water heater.

b. Students should perform an operational check of the electric water heater.

c. V'TECS, Appliance Repairer, Task No. 10

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
d. Locate information in reference materials
e. Draw conclusions
f. Interpret non-graphic information
g. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-11 Troubleshooting and replacing electric water heater elements

PERFORMANCE STATEMENT

Troubleshoot and replace electric water heater elements.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Type of water heaters (conventional, cabinet)
b. Capacity of water heaters
c. Number and type of elements used (immersion, external)
d. Thermostats
e. Circuits (duplex, load-limiting)
f. Color coding
g. Model and serial number coding
h. Relief valves
i. Checking the element
j. Draining the unit replacing the element

Provide Demonstration On:

a. Troubleshooting element burnout
b. Replacing the element

Provide Practical Application On:

a. Making a determination if the element is defective
b. Replacing the element

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 1

Tools and Equipment:

a. VOM
b. Various heating element styles
c. Cut-a-way of two element heater
d. Hand tools
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a water heater with a defective heating element and necessary tools and equipment, the student will locate the problem and remove and replace the element according to the manufacturer's specifications. Upon completion, the water heater must function properly with no water leakage.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to drain an electric water heating unit prior to replacing the heating element.

b. V'TECS, Appliance Repairer, Task No. 40

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-12 Troubleshooting and replacing electric water heater thermostat

PERFORMANCE STATEMENT

Troubleshoot and replace electric water heater thermostat(s)

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Number and type of thermostats used (immersion, external)
b. Thermostat construction
c. Circuits (duplex, load-limiting)
d. Color coding
e. Model and serial number coding
f. Adjusting the thermostat

Provide Demonstration On:

a. Troubleshooting thermostat problems with VOM
b. Replacing the thermostat

Provide Practical Application On:

a. Determining if the element or thermostat is defective
b. Replacing and adjusting the thermostat

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 1

Tools and Equipment:

a. VOM
b. Various thermostat styles
c. Cut-a-way of two element heater
d. Hand tools
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a water heater with a defective thermostat and necessary tools and equipment, the student will locate the problem and remove and replace the thermostat according to the manufacturer's specifications. Upon completion, the water heater must function properly with no water leakage.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to determine the number and type of thermostat used in a given electric water heater.

b. V'TECS, Appliance Repairer, Task No. 20

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-13 Installing and wiring a trash compactor

PERFORMANCE STATEMENT

Install and wire a trash compactor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical and mechanical safety
b. Uncrating and preparing appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Determining size and type of wire, number of conductors and amperage rating of a receptacle for a given trash compactor
b. Installing and wiring the compactor
c. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Mullin, Electrical Wiring-Residential
c. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

AAVIM, "Electrical Wiring" (ST)

Student Manuals:

AAVIM, Electrical Wiring, Unit 305SW

Tools and Equipment:

a. Shop tools
b. Various wire sizes and receptacles
c. Appliances
d. NEC manual
e. Local codes

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a trash compactor and necessary tools and equipment, the student will install and wire the compactor in accorcance with the National Electric Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors, and amperage rating of the receptacle for a given trash compactor.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Interpret non-graphic information
e. Interpret graphic data

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-14 Troubleshooting a trash compactor

PERFORMANCE STATEMENT

Troubleshoot a trash compactor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Trash compactor theory
b. Trash compactor components
c. Testing and inspecting procedures

Provide Demonstration On:

a. Testing trash compactor components
b. Repairing/replacing components

Provide Practical Application On:

Testing and repairing/replacing trash compactor components

INSTRUCTIONAL MATERIALS

Textbooks:

Manufacturer's manual

Tools and Equipment:

a. Trash compactor
b. Trash compactor components
c. Manufacturer's test equipment
d. Shop tools

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a defective trash compactor, and necessary tools and equipment, the student will locate the problem and repair/replace as needed according to the manufacturer's requirements and standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test and repair/replace trash compactor components.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-15 Installing and wiring a microwave oven

PERFORMANCE STATEMENT

Install and wire a microwave oven.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Determining size and type of wire, number of conductors and amperage rating of receptacle for a given microwave oven
b. Installing and wiring unit
c. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Mix, Housewiring Simplified
c. Mullin, Electrical Wiring - Residential

A/Vs:

AAVIM, "Electrical Wiring" (ST)

Student Manuals:

AAVIM, Electrical Wiring, Unit 305SW

Tools and Equipment:

a. Shop tools
b. Various wire sizes and receptacles
c. Microwave oven
d. NEC manual
e. Local codes
f. VOM
g. Ammeter

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a microwave oven and necessary tools and equipment, the student will determine correct wire specifications and install and wire the oven in accordance with the National Electric Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors, and amperage rating of receptacle for a given microwave oven.

b. Use resources provided in the Instructional Materials section on the previous page.

c. Students should be given a performance test to assess their ability to install a microwave oven and to make the appropriate wiring connections.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-16 Troubleshooting and repairing microwave ovens

PERFORMANCE STATEMENT

Troubleshoot and repair microwave ovens.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Microwave theory
b. Oven components, mechanical and electronic
c. Magnetron tubes
d. Door locks
e. Cabinets
f. Cabinet interior
g. Lighting
h. Controls
i. Timers, mechanical and electronic
j. Temperature probes
k. Manufacturer's test equipment
l. Microprocessors

Provide Demonstration On:

a. Testing microwave components
b. Replacing components

Provide Practical Application On:

Testing and replacing microwave oven components

INSTRUCTIONAL MATERIALS

Textbooks:

Manufacturer's manual

Tools and Equipment:

a. Microwave oven
b. Microwave components
c. Manufacturer's test equipment
d. VOM

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a defective microwave oven and necessary tools and equipment, the student will locate the problem and repair as needed. The microwave must function according to manufacturer's specification and all work must meet given requirements.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test and repair or replace microwave oven components.

b. V'TECS, Appliance Repairer, Task Nos. 30, 85, 86, 87, 88, 93

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Interpret graphic data

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret non-graphic information
g. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CR[illegible])

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA- 17 Installing, wiring and plumbing a dishwasher

PERFORMANCE STATEMENT

Install, wire and plumb a dishwasher.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Plumbing procedures
h. Tools required
i. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Determing size and type of wire, number of conductors and amperage rating of receptacle for a given dishwasher
b. Installing necessary plumbing
c. Installing wiring
d. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Mullin, Electrical Wiring-Residential
c. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

AAVIM, "Electrical Wiring" (ST)

Student Manuals:

a. AAVIM, Electrical Wiring, Unit 305SW
b. Georgia, Major Appliances, Unit MA-06

Tools and Equipment:

a. Shop tools
b. Various wire sizes and receptacles
c. Dishwasher
d. NEC manual
e. Local codes
f. Plumbing equipment
g. VOM
h. Ammeter

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 16

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a dishwasher and necessary tools and equipment, the student will determine correct wire specifications and install, wire and plumb the dishwasher in accordance with the National Electrical Code and local codes. No visible water leaks are allowed.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors and amperage rating of receptacle for a given type of dishwasher.

b. Students should perform an operational check on the dishwasher.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 3

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Recognize relevance of data
e. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-18 Troubleshooting and replacing dishwasher water level control and door switches

PERFORMANCE STATEMENT

Troubleshoot and replace dishwasher level control and door switches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location and description of switches
b. Testing the switches
c. Interaction of timer and switches
d. Electronic components

Provide Demonstration On:

Testing the switches

Provide Practical Application On:

Testing, removing and replacing the water level control switch and door switch

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

Student Manuals:

Georgia, Major Appliances, Unit MA-19

Tools and Equipment:

a. VOM
b. Hand tools
c. Switches
d. Dishwasher
e. Wiring schematic
f. Manufacturer's test equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic dishwasher and necessary tools and equipment, the student will test and replace the water level control and door switch. Installation of the parts must be within manufacturer's specifications and the machine must operate as intended by the manufacturer.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to locate and describe different types of switches.

b. Students should be given a performance test to assess their ability to test, remove and replace a door switch.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 19

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Interpret graphic data

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-19 Troubleshooting and replacing the dishwasher timer and solenoids

PERFORMANCE STATEMENT

Troubleshoot and replace the dishwasher timer and solenoids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of timer
b. Timer motor
c. Timer contacts
d. Testing the timer
e. Function and operation of solenoids
f. Solenoids found on dishwashers
g. Testing the solenoid
h. Interaction of timer and solenoids
i. Wiring schematic
j. Electronic timers

Provide Demonstration On:

a. Testing and replacing timer
b. Testing and replacing solenoids

Provide Practical Application On:

Testing, removing, and replacing the timer, fill valve solenoid and dispenser solenoid(s)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

Student Manuals:

Georgia, Major Appliances, Units MA-18, MA-21, MA-24

Tools and Equipment:

a. VOM
b. Hand tools
c. Timers and solenoids
d. Dishwasher
e. Wiring schematics
f. Shop manual
g. Manufacturer's test equipment

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic dishwasher and necessary tools and equipment, the student will test and replace the timer and fill valve solenoid and dispenser solenoid. Useability of timer and solenoid must be within manufacturer's specifications and the machine must operate as intended by the manufacturer.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding the function and interaction of the timer and solenoids.

b. Students should be given a performance test to assess their ability to wire a schematic.

c. Students should be given a performance test to assess their ability to troubleshoot an electronic timer.

d. Georgia, Electromechanical Instructor Guide - Checkpoints Information

e. V'TECS, Appliance Repairer, Task No. 45

f. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Interpret graphic data

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications
e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-20 Troubleshooting and replacing the dishwasher motor and relay

PERFORMANCE STATEMENT

Troubleshoot and replace the dishwasher motor and relay.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of relay
b. Purpose of relay
c. Interaction of timer, motor and relay
d. Motor classification
e. Testing the motor

Provide Demonstration On:

Testing the motor and relay

Provide Practical Application On:

Testing, removing, and replacing the motor and relay

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

Student Manuals:

Georgia, Major Appliances, Unit MA-21

Tools and Equipment:

a. VOM
b. Hand tools
c. Motor and relay
d. Dishwasher
e. Wiring schematic
f. Shop manual
g. Manufacturer's test equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic dishwasher and necessary tools and equipment, the student will test and replace the motor and relay. Installation of the parts must be within the manufacturer's specifications and the machine must operate as intended by the manufacturer.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding (1) the purpose and operation of the motor and relay and (2) the interaction of the timer, motor and relay.

b. Students should perform an operational check of the replaced motor and relay.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 27

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Interpret graphic data

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Interpret graphic data

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications
e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-21 Troubleshooting and replacing or repairing the dishwasher drain pump

PERFORMANCE STATEMENT

Troubleshoot and replace or repair the dishwasher drain pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location and description of drain pump
b. Types of pumps
c. Testing the pump for proper operation
d. Removing and replacing pump

Provide Demonstration On:

Testing, removing and replacing drain pump

Provide Practical Application On:

Testing, removing and replacing drain pump

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

Student Manuals:

Georgia, Major Appliances, Unit MA-23

Tools and Equipment:

a. VOM
b. Hand tools
c. Drain pumps
d. Dishwasher
e. Wiring schematic
f. Shop manual
g. Manufacturer's test equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic dishwasher and necessary tools and equipment, the student will test and replace the drain pump. Installation of the parts must be within the manufacturer's specifications and the machine must operate as intended by the manufacturer.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to identify types of pumps.

b. Students should perform an operational check of the replaced drain pump.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Interpret graphic data
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Interpret graphic data
Communication Skills
a. Organize information
b. Interprat aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-22 Troubleshooting/replacing the dishwasher heating element and thermostat

PERFORMANCE STATEMENT

Troubleshoot and replace the dishwasher heating element and thermostat.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location and description of heating element and thermostat
b. Testing the heating element and thermostat
c. Interaction of the timer, thermostat and heating element

Provide Demonstration On:

Testing heating element and thermostat

Provide Practical Application On:

Testing, removing and replacing heating element and thermostat

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

Student Manuals:

Georgia, Major Appliances, Unit MA-20

Tools and Equipment:

a. VOM
b. Hand tools
c. Elements and thermostats
d. Dishwasher
e. Wiring schematic
f. Shop manual
g. Manufacturer's test equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic dishwasher and necessary tools and equipment, the student will test and replace heating element and thermostat. Installation of the parts must be within manufacturer's specifications and the machine must operate as intended by the manufacturer.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge regarding the timer, thermostat and heating element.

b. Students should perform an operational check of the heating element and thermostat.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task Nos. 20, 40

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Interpret graphic data
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications
e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-23 Troubleshooting and replacing the dishwasher automatic dispenser

PERFORMANCE STATEMENT

Troubleshoot and replace the dishwasher automatic dispenser.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation (bi-metal or linkage)
b. Purpose of timed dispensing
c. Interaction of timer and dispenser

Provide Demonstration On:

Testing the dispenser operation

Provide Practical Application On:

Testing, removing and replacing the soap and wetting agent dispenser

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

Student Manuals:

Georgia, Major Appliances, Unit MA-22

Tools and Equipment:

a. VOM
b. Hand tools
c. Dispensers
d. Dishwasher
e. Wiring schematic
f. Shop manual
g. Manufacturer's test equipment

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an automatic dishwasher and necessary tools and equipment, the student will test and replace the soap and wetting agent dispensers. Installation of parts must be within manufacturer's specifications and the machine must operate as intended by the manufacturer.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the purpose of timed dispensing.

b. Students should be given a performance test to assess their ability to explain the operation of a dishwasher automatic dispenser.

c. V'TECS, Appliance Repairer, Task No. 59

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Interpret graphic data
Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications
e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-24 Installing and wiring an electric range, surface unit or wall oven

PERFORMANCE STATEMENT

Install and wire an electric range, surface unit or wall oven.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Determining size and type of wire, number of conductors and amperage rating of receptacle for a given electric range, surface unit or wall oven
b. Installing a range pigtail
c. Making operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Alerich, Electrical Construction Wiring
b. Manufacturer's manual
c. Mullin, Electrical Wiring - Residential
d. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

a. Georgia, "Installing Electric Range" (ST); "Transporting Major Appliances" (ST)
b. AAVIM, "Electrical Wiring" (ST)

Tools and Equipment:

a. Shop tools
b. Various wire sizes and receptacles
c. Appliances
d. NEC
e. Local codes

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 10

Performance Objective (CRM)

Given an electric range surface unit or wall oven and necessary tools and equipment, the student will determine correct wire specifications and install and wire in accordance with the NEC and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to determine the electrical requirements for a given electric range, surface unit or wall oven.

b. Georgia, Electromechanical Instructor Guide - Checkpoints Information

c. V'TECS, Appliance Repairer, Task Nos. 4 and 5

d. NEC manual

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-25 Troubleshooting and replacing surface unit and oven heating elements

PERFORMANCE STATEMENT

Troubleshoot and replace surface unit and oven heating elements.

INSTRUCTIONAL ACTIVITIES

Provide Information:

a. Safety precautions
b. Element description and function
c. Testing the elements
d. Removal procedures
e. Tool list

Provide Demonstration On:

a. Testing the element
b. Removing the element

Provide Practical Application On:

a. Testing all surface unit elements
b. Testing oven unit element
c. Replacing any defective elements found

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 1

A/Vs:

Georgia, "Test and Replace a Surface Unit Element" (ST)

Student Manuals:

Georgia, Major Appliances, Units MA-26, MA-28

Tools and Equipment:

a. VOM
b. Several different styles and types of elements
c. Shop manual
d. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electric range and necessary tools and equipment, the student will test each element and record the information. All defective elements must be identified. The defective element must be replaced to conform with manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to follow correct and safe procedures for removing a defective heating element.

b. Georgia, Electromechanical Instructor Guide - Checkpoints Information

c. V'TECS, Appliance Repairer, Task No. 46

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference matetrials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-26 Troubleshooting and replacing surface unit and oven temperature control switches and thermostats

PERFORMANCE STATEMENT

Troubleshoot and replace surface unit and oven temperature control switches and thermostats.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety precautions
b. Thermostat function
c. Switch function
d. Types of switches
e. Electrical connections
f. Tools
g. Adjusting oven thermostats

Provide Demonstration On:

a. Electrical connections
b. Testing procedures

Provide Practical Application On:

a. Testing all surface unit switches and thermostats if used
b. Testing oven control switches and thermostat
c. Adjusting an oven thermostat

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 1

Student Manuals:

Georgia, Major Appliances, Units MA-27, MA-29

Tools and Equipment:

a. Shop tools
b. Assortment of switches and thermostats
c. VOM
d. Thermometer
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electric range and necessary tools and equpiment, the student will test each switch and the oven thermostat and record the information. All defective switches and thermostats must be identified. The defective switch and/or thermostat must be replaced to conform with manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate switches and thermostat for a given range.

b. Georgia, Electromechanical Instructor Guide - Checkpoints Information

c. V'TECS, Appliance Repairer, Task Nos. 11, 14, 15, 18, 20 and 23.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-27 Troubleshooting and replacing the electric oven timer

PERFORMANCE STATEMENT

Troubleshoot and replace the electric oven timer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety precautions
b. Timer function
c. Purpose of service timer
d. Types of timers
e. Checking contact points
f. Tools needed

Provide Demonstration On:

a. Checking contact points
b. Testing procedures

Provide Practical Application On:

Testing and replacing the timer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Ruel and Nolte, Servicing Electrical Appliances, Vol. 1

Student Manuals:

Georgia, Major Appliances, Unit MA-30

Tools and Equipment:

a. Shop tools
b. Assortment of timers
c. VOM
d. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electric range with defective timer and necessary tools and equipment, the student will test the timer and record the information. The timer must be replaced to conform with manufacturer's specifications. All recorded information must be equal to known values.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to check the contact points.

b. Students should perform an opperational check of the replaced timer.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task Nos. 14 and 21

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-28 Installing and wiring a cook top and vent

PERFORMANCE STATEMENT

Install and wire a cook top and vent.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of cook tops (standard, ceramic)
b. Electrical safety
c. Uncrating and preparing the appliance
d. Determining electrical requirements
e. Using the power formula
f. The National Electric Code (NEC)
g. Installation procedures
h. Tools required
i. Operational checks

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Installing cook top and vent
b. Determining size and type of wire, number of conductors and amperage rating of receptacle for a given cook top
c. Making operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Alerich, Electrical Construction Wiring
b. Manufacturer's manual
c. Mullin, Electrical Wiring-Residential
d. Ruel and Nolte, Servicing Electrical Appliances, Vol. 2

A/Vs:

a. Georgia, "Installing Surface Unit and Hood" (ST)
b. AAVIM, "Electrical Wiring" (ST)

Student Manuals:

a. AAVIM, Electrical Wiring,
b. Georgia, Major Appliances, Unit MA-03

Tools and Equipment:

a. Shop tools
b. Various wire sizes and receptacles
c. Appliances
d. NEC manual
e. Local codes

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electric cook top, vent and a prepared counter surface and necessary tools and equipment, the student will determine correct wire specifications and install and wire the units in accordance with the National Electric Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors, and amperage rating of receptacle for a given type of cook top and vent.

b. Students should perform an operational check of the cook top and vent.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Squares and square roots

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data

(continued on next page)

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-29 Troubleshooting ceramic or conventional cook tops

PERFORMANCE STATEMENT

Troubleshoot a ceramic or a conventional cook top.

INSTRUCTIONAL ACTIVITIES

Prerequisite Task:

MA-01

Provide Information On:

a. Characteristics of ceramic cook tops
b. Comparison of ceramic to conventional heating element
c. Heating elements
d. Temperature control
e. Testing precautions
f. Removing and reinstalling

Provide Demonstration On:

a. Removing and replacing ceramic or conventional cook top
b. Testing and replacing heating elements

Provide Practical Application On:

Testing, removing and replacing a ceramic or a conventional cook top

INSTRUCTIONAL MATERIALS

Textbooks:

Manufacturer's manual

Tools and Equipment:

a. Range with ceramic or conventional cook top
b. Built in cook top
c. Test equipment
d. Hand tools
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a ceramic or a conventional cook top with a faulty heating element and necessary tools and equipment, the student will locate the problem and repair it. The cook top must operate within the manufacturer's specifications. All work must conform to given requirements.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test and repair or replace a defective cook top.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-30 Identifying and describing the function of the refrigeration components

PERFORMANCE STATEMENT

Identify and describe the function of the refrigeration components.

INSTRUCTIONAL ACTIVITIES

Prerequisite Tasks:

RF-01 through RF-16

Provide Information On:

a. Compressor (reciprocal and rotary)
b. Oil-cooler
c. Discharge line
d. Condenser (forced air and static)
e. Liquid line
f. Filter-dryer
g. Metering device
h. Evaporator (shell, fin, shelf)
i. Suction line
j. Freezers (chest and upright)
k. Refrigerators
l. Ice makers

Provide Demonstration On:

a. Identifying components on refrigerators and freezers
b. Describing function of each component

Provide Practical Application On:

Identifying various refrigerator and freezer components

INSTRUCTIONAL MATERIALS

Textbooks:

Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Understanding Basic Operation" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-33
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. All basic refrigeration components
b. Refrigeration cut-a-way
c. Charts and diagrams of system

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer, the student will identify all refrigeration components with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of the basic refrigeration components by writing the description and function of each component.

b. MAVCC, Air Conditioning and Refrigeration, Teacher Edition, Book Two, 1977

c. Georgia, Electromechanical Instructor Guide- Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-31 Installing and wiring a refrigerator and/or freezer

PERFORMANCE STATEMENT

Install and wire a refrigerator and/or freezer.

INSTRUCTIONAL ACTIVITIES

Prerequisite Tasks:

RF-33 and RF-34

Provide Information On:

a. Electrical safety
b. Uncrating and preparing the appliance
c. Determining electrical requirements
d. Using the power formula
e. The National Electric Code (NEC)
f. Installation procedures
g. Tools required
h. Operational checks
h. Ice maker options

Provide Demonstration On:

a. Using NEC to determine requirements
b. Making wiring connections
c. Typical installations

Provide Practical Application On:

a. Determining size and type of wire, number of conductors and amperage rating of receptacle for a given refrigerator or freezer
b. Installing and wiring appliances
c. Leveling appliances
d. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Mullin, Electrical Wiring-Residential

A/Vs:

a. AAVIM, "Electrical Wiring" (ST)
b. Georgia, "Transporting Major Appliances" (ST)

Student Manuals:

a. AAVIM, Electrical Wiring, Unit 305SW
b. Georgia, Major Appliances, Units MA-08, MA-09

Tools and Equipment:

a. Shop tools
b. Various wire sizes and receptacles
c. Refrigerator
d. NEC manual
e. Local codes

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator and necessary tools and equipment, the student will determine correct wire specifications and install and wire the refrigerator in accordance with the National Electric Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to select the appropriate size and type of wire, number of conductors and amperage rating of receptacle for a given type of refrigerator and/or freezer.

b. Students should perform an operational check of the refrigerator and/or freezer.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 2

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-32 Troubleshooting and replacing refrigeration components

PERFORMANCE STATEMENT

Troubleshoot and replace refrigeration components.

INSTRUCTIONAL ACTIVITIES

Prerequisite Tasks:

RF-01 through RF-16

Provide Information On:

a. Frost patterns
b. Restrictions
c. Low refrigerant (leaks)
d. Recording temperatures
e. High pressures
f. Low pressures
g. Air leaks (door gasket)
h. Moisture contamination
i. Thermostat problems
j. Compressor electrical failure
k. Compressor mechanical failure
l. Testing compressor motor

Provide Demonstration On:

Locating a known problem in a refrigerator or freezer refrigeration cycle

Provide Practical Application On:

Locating the cause of a refrigeration failure on an operable refrigerator/ freezer with known condition

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Doolin, Doolin's Troubleshooter's Bible
c. Manufacturer's manual

A/Vs:

Georgia, "Troubleshooting Refrigeration Cycle" (ST), "Troubleshooting Compressor Burnout" (ST)

Student Manuals:

a. Georgia, Refrigeration, Units REF-35, REF-37
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. Refrigerator with known problem
b. Manifold gauges
c. Leak detection equipment
d. VOM
e. Troubleshooting charts
f. Manufacturer's test equipment

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 20

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a defective refrigerator and/or freezer and necessary tools and equipment, the student will identify all defective refrigeration components and replace according to manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot a compressor for mechanical and/or electrical failure.

b. MAVCC, Air Conditioning and Refrigeration, Teacher Edition Book Two, 1977

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
f. Squares and square roots

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-33 Evacuating and charging domestic refrigerator and freezer systems

PERFORMANCE STATEMENT

Evacuate and charge domestic refrigerator and freezer systems.

INSTRUCTIONAL ACTIVITIES

Prerequisite Tasks:

RF-06 through RF-09; RF-13 through RF-16

Provide Information On:

a. Installing access valves (styles and types)
b. Triple evacuation
c. Deep evacuation
d. Purpose of evacuation
e. Safety while handling refrigerants
f. Charging with liquid
g. Charging with vapor
h. Sealing the system
i. Testing for leaks

Provide Demonstration On:

Going through complete evacuation and charging procedures on a refrigerator or freezer

Provide Practical Application On:

Evacuating and charging a refrigerator or freezer by liquid and vapor method

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, "Evacuating and Charging Refrigerators and Freezers" (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-34
b. MAVCC, Air Conditioning and Refrigeration, Book One

Tools and Equipment:

a. Access valves
b. Refrigerator system
c. Vacuum pump
d. Manifold gauge
e. Refrigerant
f. Safety glasses
g. High vacuum gauge
h. Leak detector (electronic and halide torch)
i. Soap
j. Pinch off tool and soldering equipment
k. Manufacturer's test equipment

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer and necessary tools and equipment, the student will evacuate, charge and leak test the system. The amount of refrigerant and depth of evacuation must be within manufacturer's specifications. All leaks, if any, must be detected.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use the liquid and vapor methods for evacuating and charging a refrigerator and/or freezer.

b. MAVCC, Air Conditioning and Refrigeration, Teacher Edition, Book One, 1977

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Metric conversion
g. Squares and square roots
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-34 Troubleshooting and replacing electrical components of a refrigerator and/or freezer

PERFORMANCE STATEMENT

Troubleshoot and replace electrical components of a refrigerator and/or freezer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of evaporator fan motor
b. Function of condenser fan motor
c. Restricted or no air switch
d. Checking motor and switch
e. Wiring schematics
f. Ice maker systems

Provide Demonstration On:

a. Checking fan motors and switches
b. Interpreting wiring schematics

Provide Practical Application On:

a. Checking out condenser and evaporator motors
b. Cleaning or replacing motor switches
c. Checking and replacing motor switches
d. Installing ice maker kit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Manufacturer's manual

A/Vs:

Georgia, "Troubleshooting Fans and Fan Motors (ST)

Student Manuals:

a. Georgia, Refrigeration, Unit REF-36
b. MAVCC, Air Conditioning and Refrigeration, Book Two

Tools and Equipment:

a. Refrigerator with wiring schematic attached to back
b. VOM
c. Manufacturer's test equipment

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a refrigerator or freezer and necessary tools and equipment, the student will test all fan motors and switches, determine the condition and replace as necessary. Electrical components must be identified and replaced according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot and replace electrical components on a refrigerator and/or freezer.

b. Students should be given a performance test to assess their ability to install an ice maker.

c. MAVCC, Air Conditioning and Refrigeration, Teacher Edition, Book Two, 1977

d. Georgia, Electromechanical Instructor Guide - Checkpoints Information

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
f. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-35 Installing and plumbing a gas clothes dryer

PERFORMANCE STATEMENT

Install and plumb a gas clothes dryer.

INSTRUCTIONAL ACTIVITIES

Prerequisite Tasks:

RF-06 through RF-08

Provide Information On:

a. Natural gas properties
b. Safety
c. The *National Fuel Gas Code*
d. Uncrating and preparing the appliance
e. Piping and fittings
f. Plumbing procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Proper gas piping installation
b. Interpreting the *National Fuel Gas Code*
c. Final checks

Provide Practical Application On:

a. Installing gas piping and hooking up the dryer
b. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. Oravetz, *Plumbers and Pipefitters Library*

A/Vs:

Georgia, "Applying Gas Fuel Combustion and Safety Principles" (ST), "Gas Piping Principles" (ST)

Student Manuals:

Georgia, *Heating*, Units HE-04a, HE-07

Tools and Equipment:

a. *National Fuel Gas Code*
b. Local codes
c. Gas dryer
d. Piping materials and tools

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 16

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas clothers dryer and necessary tools and equipment, the student will run piping and install and check out the dryer for proper operation. No gas leaks are permitted and all work must conform to the National Fuel Gas Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to perform tubing and piping operations.

b. Students should be given a performance test to assess their ability to install gas piping and to hook up a gas clothes dryer.

c. Students should perform an operational check of the clothes dryer.

d. Georgia, Electromechanical Instructor Guide - Checkpoints Information

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Squares and square roots

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-36 Troubleshooting and servicing gas clothes dryer mechanical/electrical systems

PERFORMANCE STATEMENT

Troubleshoot and service gas clothes dryer mechanical/electrical systems.

INSTRUCTIONAL ACTIVITIES

Prerequisite Task:

MA-01

Provide Information On:

a. Component identification
b. Visual inspection
c. Belt function and inspection
d. Drum inspection
e. Air leaks
f. Electrical components
g. Drive motor
h. Timer
i. Automatic pilot (electric)

Provide Demonstration On:

a. Replacing belt
b. Replacing drum
c. Adjusting door
d. Replacing motor

Provide Practical Application On:

a. Inspecting and replacing belt and drum
b. Adjusting door
c. Replacing motor and timer

INSTRUCTIONAL MATERIALS

Textbooks:

Manufacturer's manual

Tools and Equipment:

a. Gas dryer
b. Components
c. Shop manual
d. Manufacturer's test equipment
e. VOM

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas clothes dryer with known malfunctions in the mechanical and electrical systems and necessary tools and equipment, the student will locate all problems and repair them as needed. Troubleshooting techniques must be systematic and effective. Repairs must be according to manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot the mechanical and electrical systems of a gas clothes dryer.

b. Students should be given a performance test to assess their ability to remove and replace defective components of the mechanical and electrical systems.

c. V'TECS, Appliance Repairer, Task No. 16

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information

b. Interpret aural communications

c. Compose oral directions and questions

d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-37 Troubleshooting, replacing and adjusting dryer gas controls

PERFORMANCE STATEMENT

Troubleshoot, replace and adjust dryer gas controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electromagnetic safety system
b. Gas pressure regulator
c. Regulator adjustment
d. Relighting the pilot
e. Main dryer valve
f. Main burner solenoid
g. Automatic ignition
h. High limit, cycling and auxilary thermostat
i. Thermocouple

Provide Demonstration On:

a. Testing safety devices
b. Adjusting regulator
c. Replacing controls

Provide Practical Application On:

a. Testing and adjusting all controls
b. Removing and replacing controls

INSTRUCTIONAL MATERIALS

Textbooks:

Manufacturer's manual

Student Manuals:

National Training Aids, Fundamentals of Gas Control Systems, Student Workbook

Tools and Equipment:

a. Gas dryer
b. Components
c. Hand tools
d. Manufacturer's test equipment
e. VOM

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas clothes dryer with faulty gas controls and necessary tools and equipment, the student will locate and correct the problem. Upon completion, the dryer must maintain temperatures within specifications and all safety devices must work as designed.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test gas controls on a gas clothes dryer.

b. Students should be given a performance test to assess their ability to remove defective gas controls and replace them with new controls.

c. V'TECS, Appliance Repairer, Task No. 17

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-38 Installing and plumbing a gas water heater

PERFORMANCE STATEMENT

Install and plumb a gas water heater.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Natural gas properties
b. Safety
c. The National Fuel Gas Code
d. Uncrating and preparing the appliance
e. Piping and fittings
f. Plumbing procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Proper gas piping installation
b. Interpreting the National Fuel Gas Code
c. Performing operational checks

Provide Practical Application On:

a. Installing gas piping and hooking up water heater
b. Installing water piping
c. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, *Water Heating Service Training Manual*
c. Oravetz, *Plumbers and Pipefitters Library*
d. Slater and Smith, *Basic Plumbing*

A/Vs:

Georgia, "Applying Gas Fuel Combustion and Safety Principles" (ST), "Gas Piping Principles" (ST)

Student Manuals:

Georgia, *Heating*, Units HE-04, HE-07

Tools and Equipment:

a. *National Fuel Gas Code* manual
b. Local codes
c. Gas range
d. Piping materials and tools

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 16

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas water heater and necessary tools and equipment, the student will run gas and water piping and install a gas water heater. No gas or water leaks are permitted and all work must conform to the National Fuel Gas Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use safe and correct installation procedures.

b. Students should perform an operational check of the gas water heater.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-39 Troubleshooting and replacing gas water heater relief valves

PERFORMANCE STATEMENT

Troubleshoot and replace gas water heater relief valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Water vapor presure
b. Purpose of relief valves
    1. Pressure relief valves
    2. Temperature relief valves
    3. Combination relief valves
c. Valve components
d. Location of valve
e. Testing the valve
f. Possible malfunctions

Provide Demonstration On:

Testing and replacing all three types of relief valves

Provide Practical Application On:

a. Testing relief valves
b. Replacing relief valves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Water Heating Service Training Manual

Student Manuals:

National Training Aids, Gas Water Heating Systems, Student Workbook

Tools and Equipment:

a. Various relief valves
b. Hand tools
c. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas hot water heater with a defective relief valve, necessary tools and equipment, the student will evaluate the condition and replace the valve. The work must conform to NFGC.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to troubleshoot and replace the following types of relief valves: pressure, temperature and combination.

b. V'TECS, Appliance Repairer, Task No. 57

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-40 Troubleshooting, replacing and adjusting water heater gas controls

PERFORMANCE STATEMENT

Troubleshoot, replace and adjust water heater gas controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electromagnetic safety system
b. Energy cutoff device
c. Gas pressure regulator
d. Regulator adjustment
e. Relighting the pilot
f. Automatic pilot

Provide Demonstration On:

a. Testing safety devices
b. Adjusting regulator
c. Replacing controls

Provide Practical Application On:

a. Testing and adjusting all controls
b. Removing and replacing controls

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Water Heating Service Training Manual

Student Manuals:

National Training Aids, Gas Water Heating Systems, Student Workbook

Tools and Equipment:

a. Water heater controls
b. Manufacturer's test equipment
c. Hand tools

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas water heater with faulty gas controls and necessary tools and equipment, the student will locate and correct the problem. Upon completion the water must be heated and automatically maintained at a specified temperature.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test all gas controls and replace those determined to be defective.

b. V'TECS, Appliance Repairer, Task Nos. 12, 07, and 08

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-41 Troubleshooting and replacing gas water heater thermostats

PERFORMANCE STATEMENT

Troubleshoot and replace gas water heater thermostat.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rod and tube assembly
b. Clicker mechanism
c. Testing procedures
d. Adjustment of thermostat

Provide Demonstration On:

Testing and replacing thermostat

Provide Practical Application On:

Testing and replacing thermostat

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Water Heating Service Training Manual

Student Manuals:

National Training Aids, Gas Water Heating Systems, Student Workbook

Tools and Equipment:

a. Water heater thermostat
b. Hand tools
c. Manufacturer's test equipment
d. VOM

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas water heater with a faulty thermostat and necessary tools and equipment, the student will determine serviceability and remove and replace the thermostat. Serviceability decisions must be 100% accurate and all work must conform to NFGC and manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to adjust a thermostat.

b. V'TECS, Appliance Repairer, Task No. 2C

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-42 Installing and plumbing a gas range or a wall oven and surface unit

PERFORMANCE STATEMENT

Install and plumb a gas range or a wall oven and surface unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Natural gas properties
b. Safety
c. The National Fuel Gas Code
d. Uncrating and preparing the appliance
e. Piping and fittings
f. Plumbing procedures
g. Tools required
h. Operational checks

Provide Demonstration On:

a. Proper gas piping installation
b. Interpreting the National Fuel Gas Code
c. Final checks

Provide Practical Application On:

a. Installing gas piping and hooking up stove
b. Performing operational checks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Cooking Service Training Manual
c. Oravetz, Plumbers and Pipefitters Library

A/Vs:

Georgia, "Applying Gas Fuel Combustion and Safety Principles" (ST), "Transporting Major Appliances" (ST), "Gas Piping Principles" (ST)

Student Manuals:

Georgia, Heating, Units HE-04, HE-07; Major Appliances, Unit MA-09

Tools and Equipment:

a. National Fuel Gas Code manual
b. Local codes
c. Gas range
d. Piping materials and tools

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 14

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas range and necessary tools and equipment, the student will run piping and install and plumb a gas range or a wall oven and surface unit. No gas leaks are permitted and all work must conform to the National Fuel Gas Code and local codes.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use safe and correct installation procedures.

b. Students should perform an operational check of the gas range or wall oven and surface unit.

c. Georgia, Electromechanical Instructor Guide - Checkpoints Information

d. V'TECS, Appliance Repairer, Task No. 7

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-43 Troubleshooting and replacing gas range controls

PERFORMANCE STATEMENT

Troubleshoot and replace gas range controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Manifold assembly
b. Surface burners
c. Surface burner controls
d. Surface burner pilot
e. Safety devices
f. Cleaning and checking burners
g. Adjusting flame
h. Thermopile assembly
i. Flame switches
j. Pilotless burners

Provide Demonstration On:

Adjusting surface burners and pilots

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Cooking Service Training Manual

Student Manuals:

National Training Aids, Fundamentals of Gas Control Systems, Student Workbook

Tools and Equipment:

a. Hand tools
b. Various controls
c. NFGC
d. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas range with surface burners improperly adjusted and malfunctioning controls, the student will repair the controls. All work must be in accordance with the NFGC and adjustments must be in accordance with the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to adjust the burner.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-44 Troubleshooting and replacing gas oven controls

PERFORMANCE STATEMENT

Troubleshoot and repair gas oven controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thermostat control
b. Direct and indirect controlled ovens
c. Hydraulic diastat control
d. Electric thermostat control
e. Multiple pilot burners
f. Temperature ranges of controls
g. Safety devices
h. Oven control checks
i. Thermostat checks
j. Flame switch checks
k. Oven timers

Provide Demonstration On:

Testing and replacement steps of thermostat and oven temperature control

Provide Practical Application On:

Testing and replacing a direct and an indirect oven temperature control system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Cooking Service Training Manual

Student Manuals:

National Training Aids, Fundamentals of Gas Controls Systems, Student Workbook

Tools and Equipment:

a. Hand tools
b. Pyrometer
c. Multimeter
d. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas oven with defective temperature controls and necessary tools and equipment, the student will determine the type of replacement control needed with 100% accuracy. The problem must be identified and all work must conform to NFGC and manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to test and replace a direct and indirect oven temperature control system.

b. V'TECS, Appliance Repairer, Task No. 12

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-45 Troubleshooting and replacing gas/electric controls

PERFORMANCE STATEMENT

Troubleshoot and replace gas/electric controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Millivolt controls
b. 115 VAC controls
c. Direct and indirect controlling systems
d. Thermopile assembly
e. Constant pilot
f. Oven control solenoid
g. Thermostat diastat
h. Flame switch
i. Testing procedures

Provide Demonstration On:

Testing controls and adjusting temperature range and flame

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Cooking Service Training Manual

Student Manuals:

National Training Aids, Fundamentals of Gas Control Systems, Student Workbook

Tools and Equipment:

a. Various gas/electric controls
b. Pyrometer
c. Thermopile adapter
d. VOM
e. Manufacturer's test equipment

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas range with defective gas/electric controls, necessary tools and equipment, the student will locate and correct problems. Identification of problem must be 100% accurate and all work must conform to NFGC and manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to adjust temperature range and flame.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion

Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-46 Troubleshooting gas lines and connections for leaks

PERFORMANCE STATEMENT

Troubleshoot gas lines and connections for leaks.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety precautions
b. Purpose of testing lines and connections
c. National Fuel Gas Code
d. Gas pressures
e. Tool list
f. Testing gas lines and connections

Provide Demonstration On:

a. Testing gas lines and connections
b. Interpreting NFGC

INSTRUCTIONAL MATERIALS

Textbooks:

Oravetz, Plumbers and Pipefitters Library

Tools and Equipment:

a. NFGC manual
b. Leak detector

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas appliance and necessary tools and equipment, the student will test gas piping for leaks from the meter to the appliance. All leaks must be found.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use proper safety precautions when testing lines and connections for leaks.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation

Problem Solving
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-47 Installing a gas orifice

PERFORMANCE STATEMENT

Install a gas orifice.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. National Fuel Gas Code
b. Purpose of orifice
c. Safety precautions
d. Typical installation
e. Operating procedures
f. Different sizes used for different gasses
g. Tool list

Provide Demonstration On:

a. Typical installation
b. Operating procedures
c. Interpreting NFGC

Provide Practical Application On:

Calculating size and installing an orifice

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Gas Heating, Cooking and Heating

Tools and Equipment:

a. Tools necessary for task
b. Manufacturer's manual
c. NFGC manual

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an operable gas appliance, an assortment of orifices and necessary tools and equipment, the student will select the proper orifice and install according to manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to calculate different sizes of orifices for different types of gasses.

b. V'TECS, Appliance Repairer, Task nos. 70 and 77

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-48 Adjusting pilot lights

PERFORMANCE STATEMENT

Adjust pilot light.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Pilot light description
b. Primary and secondary air
c. Burner tip
d. Safety devices
e. Automatic ignition devices
f. Flame sensors
g. Thermocouples
h. Bi-metal switches

Provide Demonstration On:

a. Lighting the pilot
b. Adjusting gas pressure and air
c. Checking safety devices

Provide Practical Application On:

a. Lighting and adjusting the pilot light
b. Observing functioning safety devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Gas Water Heating, Cooking and Heating

A/Vs:

Georgia, "Installing and Servicing Pilot Ignition Devices" (ST)

Student Manuals:

Georgia, Heating, Unit HE-10

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a gas appliance, the student will light and adjust the pilot light. Air/gas ratio and pressure must meet manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to observe safety procedures when adjusting pilot lights.

b. Georgia, Refrigeration, Heating and Air Conditioning, Instructor Guide - Checkpoints Information

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

MA-49 Adjusting the gas burner

PERFORMANCE STATEMENT

Adjust the gas burner.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of adjusting gas burner
b. The National Fuel Gas Code
c. Safety precautions
d. Operating the system
e. Checking gas pressure
f. Adjusting the primary air
g. Checking the bonnet temperature controls
h. Tool list

Provide Demonstration On:

a. Adjusting gas burner properly
b. Operating the system
c. Checking gas pressures
d. Interpreting the NFGC

Provide Practical Application On:

a. Adjusting all gas burners on a range and oven
b. Adjusting gas burner on a water heater
c. Adjusting gas burner on a clothes dryer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. National Training Aids, Gas Water Heating, Cooking and Heating

A/Vs:

Georgia. "Servicing Burners" (ST)

Student Manuals:

Georgia, Heating, Unit HE-12

Tools and Equipment:

a. National Fuel Gas Code
b. Draft gauge
c. Stack thermometer
d. Carbon dioxide analyzer
e. Oxygen analyzer

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 7

Performance Objective (CRM)

Given the necessary tools and equipment, the student will adjust the gas burners on a gas range, oven, hot water heater and dryer. The flame must be sharp blue, rest on burner port and not make a blowing noise.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to check the gas pressure.

b. Georgia, Electromechanical Instructor Guide - Checkpoints Information

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-01 Identifying hazardous wiring locations

PERFORMANCE STATEMENT

Identify hazardous wiring locations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hazardous locations
b. Wiring methods
c. Sealing conduits

Provide Demonstration On:

Special techniques for installing wiring in hazardous locations

Provide Practical Application On:

Installing wiring under simulated hazardous conditions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Summers, National Electrical Code

A/Vs:

Career Aids, Inc., "Electrical Safety in the Shop" (FT)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Shop tools
b. Set of prints
c. Materials catalog

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 2

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a complete set of prints for a gasoline dispensing station with a grease pit, the student will accurately classify each area of the unit as to class location and specify the wiring method to be installed. The student will select the material to be installed and installation must be in accordance with local and national code standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install wiring under hazardous conditions.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Interpret graphic information
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes, with or without units or measurements
e. Draw conclusions
f. Interpret graphic data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-02 Locating service entrance equipment and writing specifications

PERFORMANCE STATEMENT

Locate service entrance equipment and write specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location of service entrance equipment
b. Selection of service entrance equipment
c. Writing specifications
d. Service entrance wire selection
e. Conduit selection
f. Conduit bending installation
g. Grounding of service

Provide Demonstration On:

a. Wire selection
b. Conduit selection
c. Conduit bending installation

Provide Practical Application On:

a. Conduit bending installation
b. Conduit selection
c. Writing the service entrance specifications
d. Selecting service equipment
e. Installing service equipment
f. Locating service entrance equipment
g. Grounding of service

INSTRUCTIONAL MATERIALS

Textbooks:

a. Ramsey and Sleeper, Architectural Graphic Standard
b. Graham, Industrial and Commercial Wiring
c. Summers, National Electrical Code

A/Vs:

a. AAVIM, "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)
b. Singer Career Systems, "Electric Wire and Cable" (FT); "Electrical Boxes" (FT)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Complete set of prints
b. Specifications
c. Power company regulations

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a complete set of prints, specifications and power company regulations, the student will accurately complete the necessary calculations to determine the type and size of service equipment, select the correct service entrance equipment, the necessary tools and materials, and install the service equipment for a small commercial facility. All wiring must meet local and national code standards.

Suggested Testing Activities And Resources

a. Students should follow the procedure below when installing service equipment for a small commercial facility.
    1. Mount the three phase four wire service equipment on backboards secured to a concrete block wall.
    2. Make the necessary bends and install service entrance conduits.
    3. Install the service entrance and grounding conductors.
    4. Connect to service equipment.
    5. Connect service to a 115/239 three phase four wire Delta power supply.
    6. Operate and test all equipment.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

e. Interpret non-graphic information
f. Recognize relevance of data
g. Interpret graphic data
Communication Skills
a. Organize information

TASK OR UNIT COMPETENCY

IE-03 Calculating and selecting service conduits

PERFORMANCE STATEMENT

Calculate and select service conduits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of conduit
b. Size of conduit
c. Parallel conduits
d. Numbers of conductors in conduit
e. Supporting conduit

Provide Demonstration On:

a. Conduit selection
b. Conduit percent fill

Provide Practical Application On:

Conduit selection

INSTRUCTIONAL MATERIALS

Textbooks:

Summers, National Electrical Code

A/Vs:

a. AAVIM, "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)
b. Singer Career Systems, "Electrical Service Entrance" (ST)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Supply catalog
b. Equipment catalog
c. Set of prints
d. Scale

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

From a given set of prints, the student will complete the necessary calculations to determine the type and size of service conduits to be installed. All work must meet local and national electric code standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to identify and discuss the different types of conduit.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Interpret graphic data
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data
Communication Skills
a. Interpret aural communications
b. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-04 Installing service conduits

PERFORMANCE STATEMENT

Install service conduits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conduit bending
b. Conduit installing

Provide Demonstration On:

Conduit bending

Provide Practical Application On:

Conduit bending and installing

INSTRUCTIONAL MATERIALS

Textbooks:

Summers, National Electrical Code

A/Vs:

AAVIM, "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Set of prints
b. Shop tools
c. Conduit
d. Benders
e. Straps
f. Screws, nuts, bolts, etc.

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of prints, the student will select and install the appropriate type of service conduit for a given job. All work must meet local and national codes.

Suggested Testing Activities And Resources

a. Students should follow the procedure below when installing service conduits.
   1. Select the proper type of conduits.
   2. Show (layout) the service conduits on the set of prints.
   3. Show the size of conduit needed for the service.
   4. Show the size of conduits to be used in parallel for the service.
   5. Make the necessary bends, install and support the conduit.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Organize information

TASK OR UNIT COMPETENCY

IE-05 Installing outlet, junction box and conduit

PERFORMANCE STATEMENT

Install outlet, junction box and conduit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Boxes and conduit
b. Number of conductors per each
c. Number of conduits per each
d. Outlet and junction locations
e. Conduit bending and installation
f. Conduit support
g. Conduits in masonry walls
h. Conduit exposed on masonry walls
i. Branch circuits

Provide Demonstration On:

a. Boxes and selection
b. Conduit bending
c. Conduit installation

Provide Practical Application On:

a. Boxes and conduit installation
b. Conduit bending
c. Conduit installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Graham, Industrial and Commercial Wiring
c. Summers, National Electrical Code

Tools and Equipment:

a. Set of prints
b. Shop tools
c. Conduit and fittings
d. Boxes
e. Conduit benders
f. Wire
g. Fish tape

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of prints showing panel and outlet locations, the student will accurately select the proper materials, mount the required boxes and conduitlets, make the necessary conduit bends and install the conduit runs. All boxes, outlets and fittings must be within one fourth inch of specifications. All work must meet local and national code standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install branch circuit conductors and make the required wiring connection for complete installation of branch circuits.

b. The student will also operate and test wiring.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Interpret graphic data
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-06 Installing conduit under a concrete slab

PERFORMANCE STATEMENT

Install conduit under a concrete slab.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Floor boxes
b. Material selection
c. Installation of under floor conduits
d. Floor elevations

Provide Demonstration On:

Securing conduits

Provide Practical Application On:

a. Floor box installation
b. Material selection
c. Installing conduits under a slab

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Graham, Industrial and Commercial Wiring
c. Summers, National Electrical Code

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Set of prints showing floor outlets
b. Shop tools
c. Conduits, benders and tools

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given an electrical plan showing location of floor outlets and finish floor grades, the student will accurately select the necessary material, set the floor boxes to grade and install the conduit runs. All boxes and conduits must be secure to prevent dislocation while concrete floor is being poured. All work must meet local and national code standards.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install and secure conduit under a concrete slab.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Interpret graphic information
c. Interpret instructions
d. Recognize relevance of data
e. Recognize appropriate reference resources
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Interpret graphic data
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-07 Calculating branch circuit conductors and overcurrent protection

PERFORMANCE STATEMENT

Calculate branch conductors and overcurrent protection.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Branch circuit overcurrent protection
b. Type of branch circuit conductor
c. Number of conductors per branch circuit
d. Branch circuit conductor size
e. Branch circuit wiring installation and connection to overcurrent and loads

Provide Demonstration On:

a. Load calculations
b. Wire selection (type and size)
c. Branch circuit conductor installation and connection

Provide Practical Application On:

a. Calculating the load on branch circuits
b. Selecting correct wire size to be installed
c. Selecting proper type of conductors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Carr, Croft and Watt, American Electrician Handbook
b. Summers, National Electrical Code

A/Vs:

Singer Career Systems, "Circuit Breakers" (FT)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Set of prints
b. Wire
c. Power supply (panel)

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a floor plan of a commercial building, the student will accurately make the necessary calculations to determine the size and type of branch circuit conductors to be installed and the branch circuit overcurrent protection for these circuits. All calculations must meet or exceed local and national code standards.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their ability to list their materials selection on the set of prints.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Law of exponents
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Metric conversion
f. Squares and square roots
g. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Organize data into graphics
f. Interpret graphic data

Communication Skills
a. Compose sentences
b. Organize information

TASK OR UNIT COMPETENCY

IE-08 Determining sizes and types of feeders and overcurrent protection devices

PERFORMANCE STATEMENT

Determine sizes and types of feeders and overcurrent protection devices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Feeder selection
b. Overcurrent protection selection
c. Motor nameplate

Provide Demonstration On:

Feeder calculations and selections

Provide Practical Application On:

a. Selecting feeder circuit conductors
b. Selecting feeder and overcurrent protection device

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Summers, National Electrical Code

A/Vs:

Hobar Publications, "Electrical Connections and Current Control" (ST)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Set of prints
b. Types of feeders and overcurrent protection devices

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

From a given set of prints, the student will accurately complete the necessary calculations to determine the correct size and type of feeder and overcurrent protective device for a group of 480v three phase motors. Determinations should be accurate and agree with code requirements.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their ability to make appropriate calculations for a given job.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversion
c. Whole number manipulation
d. Interpret graphic data
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data
Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

IF-09 Selecting and installing a 480v208-210 three phase four wire service entrance

PERFORMANCE STATEMENT

Select and install a 480v208-210 three phase four wire service entrance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. One phase transformer bank
b. Three phase transformers
c. KVA rating
d. Panels
e. Circuit breaker selection and installation

Provide Demonstration On:

a. Selecting circuit breaker
b. Installing circuit breaker

Provide Practical Application On:

a. Making a transformer hookup
b. Installing circuit breakers (three pole, two pole, one pole)
c. Installing branch circuits from panels
d. Making a panel and service grounding

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Summers, National Electrical Code

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Shop tools
b. Set of prints
c. Catalog
d. Panels
e. Circuit breakers
f. VOM

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

From a given set of prints, the student will accurately calculate the load for a small industrial facility. The student will select the proper transformer bank and select, install and operate the service entrance panels 480v/277-208/120v three phase four wire. The student will install the circuit breakers in these panels for any loads that may be fed from the panels. Work must conform to NEC standards.

Suggested Testing Activities And Resources

a. Students should be given an oral test to discuss types of transformers and provide examples of situations in which three phase transformers are used.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Law of exponents
b. Trigonometry, right angles, sine, cosine, and tangent
c. Ratios, proportions and percents
d. Fractions and decimals usage and conversions
e. Whole number manipulation
f. Algebra
g. Metric conversion
h. Squares and square roots
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-10 Installing branch circuits and controls for air conditioning and heating

PERFORMANCE STATEMENT

Install branch circuits and controls for air conditioning and heating.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. EMT conduit
b. EMT bending
c. Motor starters and control
d. Motor starter selection and installation
e. Branch circuit and feeder calculation

Provide Demonstration On:

a. EMT bending and installation
b. Motor starter installation
c. Control selection

Provide Practical Application On:

a. EMT conduit bending
b. Motor starter installation
c. Control hookup
d. Branch circuit materials selection and installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse, Turnquist and Bracciano, Modern Refrigeration and Air Conditioning
b. Croft, Carr and Watt, American Electrician Handbook
c. Graham, Industrial and Commercial Wiring
d. Summers, National Electrical Code

A/Vs:

Bergwall, "Basic AC Electricity for Heat, Ventilation and Air Conditioning - Part One" (FT)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Set of prints
b. Shop tools
c. EMT conduit
d. Conductors
e. Motor starters
f. Power supply
g. VOM
h. Amp meter

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of prints showing the locations and ratings of electric heating and cooling equipment, the student will select material and install and operate the required branch circuits and equipment. Branch circuits wiring must be installed in proper size EMT conduit. All equipment must be mounted on three-fourth inch plywood backboard within one-eighth inch of specified measurement. All work must meet local and national code standards.

Suggested Testing Activities And Resources

a. Students should be given a performance/written test to assess their ability and knowledge to complete the necessary calculations to determine the branch circuit and feeder requirements.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information

Math Skills
a. Scientific and engineering notation
b. Law of exponents
c. Logarithms
d. Trigonometry, right angles, sine, cosine, and tangent
e. Ratios, proportions and percents
f. Fractions and decimals usage and conversions
g. Whole number manipulation
h. Algebra
i. Metric conversion
j. Squares and square roots
k. Apply formulas
l. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Compose sentences
b. Organize information
c. Write paragraphs
d. Interpret aural communications

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

e. Compose oral directions and questions
f. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-11 Installing branch circuits and controls for lighting

PERFORMANCE STATEMENT

Install branch circuits and controls for lighting.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General illumination
b. Fluorescent lighting
c. Exit lights
d. Night lights
e. Emergency lights
f. Show window lighting
g. Lighting branch circuits
h. Installing fixtures
j. Grouping lights onto branch circuits
k. Layout of lights (arrangement)
l. Amount of lights (lumens)

Provide Demonstration On:

Installing branch circuits

Provide Practical Application On:

a. Lighting branch circuit installation
b. Installation of controls
c. Branch circuit calcuiation
d. Fixture installation
e. Grouping fixtures onto branch circuits
f. Amount of required light (lumens)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Graham, Industrial and Commercial Wiring
c. Summers, National Electrical Code

A/Vs:

Bergwall, "Planning and Roughing In" (FT)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Set of prints
b. Materials catalog
c. Wiring material
d. Shop tools
e. VOM
f. Power supply

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a set of prints showing branch circuits and equipment for lighting and lighting control, the student will select the required material for installing the specificied branch circuits and controls for general illumination, exit lights, night lights, show window lighting and emergency lighting. All equipment and material selection must meet local and national code standards. All work must meet local and national code standards.

Suggested Testing Activities And Resources

a. Student should be given a performance test to assess their ability to group lights onto branch circuits.

b. Students should be given a performance test to assess their ability to install each of the following: exit light, night light, show window light, and emergency light.

c. Students should be given a written test to assess their ability to illustrate their work on a set of prints.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Law of exponents
c. Logarithms
d. Trigonometry, right angles, sine, cosine, and tangent
e. Ratios, proportions and percents
f. Fractions and decimals usage and conversions
g. Whole number manipulation
h. Algebra
i. Metric conversion
j. Squares and square roots
k. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials

Performance Objective (CRM)

Suggested Testing Activities And Resources

c. Draw conclusions
d. Recognize relevance of data
e. Organize data into graphics
f. Interpret graphic data

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-12 Calculating the 120 and 277 volt lighting load

PERFORMANCE STATEMENT

Calculate the 120 and 277 volt lighting load.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Light fixtures
b. Grouping fixtures of branch circuits
c. Arrangement of fixtures (layout)
d. Calculations for lighting
e. Selection of fixtures

Provide Demonstration On:

a. Grouping of fixtures on branch circuit
b. Fixture layout
c. Branch circuit calculations

Provide Practical Application On:

a. Laying out the light fixtures
b. Grouping the fixtures on branch circuit
c. Calculating lighting branch circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Graham, Industrial and Commercial Wiring
c. Manufacturer's manual
d. Summers, National Electrical Code

A/Vs:

Hobar, "Wiring a Switch and Lamp" (ST)

Tools and Equipment:

a. Set of prints
b. Fixture catalog
c. Fixture specifications
d. Scale

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

From a given set of prints, the student will accurately complete the necessary calculations to determine the number and type of lighting fixtures needed for proper amount of light.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to arrange lighting fixtures to achieve a desired amount of light.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials
Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Metric conversion
e. Squares and square roots
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data
Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-13 Selecting and installing a 277 volt fluorescent light

PERFORMANCE STATEMENT

Select and install a 277 volt fluorescent light.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Light output
b. Light selection
c. Placement of light
d. Operation of fluorescent light

Provide Demonstration On:

a. Calculating lighting requirements
b. Procedures for installing fluorescent light

Provide Practical Application On:

a. Calculating light output
b. Installing light

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Graham, Industrial and Commercial Wiring

A/Vs:

Bergwall, "Finishing the Installation" (FT); "Low Voltage and Special Circuits" (FT)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Shop tools
b. 277 volt fluorescent light
c. Set of prints
d. Fixture catalog

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

From a given set of prints, the student will accurately determine the number of fluorescent lights needed to provide adequate light, select the type needed, show placement of the fixtures, arrange the lights onto branch circuits, install a 277 volt fluorescent light fixture, make wiring connections and operate the light. The installations should meet all code requirements.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to install a 277 volt fluorescent light fixture.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directons and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-14 Hooking up a three phase booster transformer

PERFORMANCE STATEMENT

Hook up a three phase booster transformer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Three phase power
b. Three phase booster transformer
c. Polarity
d. Operation of booster
e. Applications
f. Connection (primary and secondary)
g. KVA rating
h. Ratio

Provide Demonstration On:

a. Three phase transformer
b. Three phase booster connection

Provide Practical Application On:

a. Three phase power
b. Three phase operation
c. Three phase booster connection (primary and secondary)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Dunlap, Siefert and Austin, Transformers

A/Vs:

Long Filmslide Service, "Transformers" (FS)

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. VOM
c. Three phase booster or three phase transformer
d. Power supply

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given three single phase transformers, the necessary test equipment, and power supplies, the student will make the proper wiring connections and operate a three phase booster transformer 208/312, check out and record all voltage readings. All wiring must meet local and national code standards and manufacturer's instructions for transformer installation.

Suggested Testing Activities And Resources

a. Students should perform an operational check of the transformer.

b. Students should be given a written test to assess their ability to record voltage readings.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Follow directions
b. Draw conclusions
c. Interpret graphic information
d. Interpet instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Law of exponents
c. Logarithms
d. Trigonometry, right angles, sine, cosine, and tangent
e. Ratios, proportions and percents
f. Fractions and decimals usage and conversions
g. Whole number manipulation
h. Metric conversion
i. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Compose sentences
b. Organize information
c. Write paragraphs

TASK OR UNIT COMPETENCY

IE-15 Making calculations for electric motors, welders and heaters

PERFORMANCE STATEMENT

Make calculations for electric motors, welders and heaters.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate information
b. Single phase motors
c. Three phase motors
d. Three phase and single phase motor information
e. Welder nameplate information
f. Single phase welders
g. Three phase welders
h. Welder operation
i. Heater nameplate information
j. Single phase electric heaters
k. Three phase electric heaters

Provide Demonstration On:

a. Operating single phase and three phase motor and welders
b. Motor nameplate information
c. Welder nameplate information
d. Operating single and three phase heaters
e. Heater nameplate information
f. Load calculations

Provide Practical Application On:

a. Motor branch circuit and feeder calculations
b. Welder branch circuit and feeder calculations
c. Heater branch circuit and feeder calculations
d. Selection of branch circuit and feeder wire size

INSTRUCTIONAL MATERIALS

Textbooks:

Summers, National Electrical Code

A/Vs:

Hobar Productions, "Electric Motors: Enclosures, Bearings and Mounting Methods" (ST)

Tools and Equipment:

Set of prints with motor and welder load

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

From a given set of prints, the student will accurately calculate the total connected motor, welder and heat load to determine the correct branch circuit wire size for each.

Suggested Testing Activities And Resources

a. Students should be given an oral test to assess their ability to explain operating procedures for single and three phase electric motors, welders and heaters.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Draw conclusions
b. Interpret graphic information
c. Recognize relevance of data
d. Recognize appropriate reference resources
e. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Law of exponents
c. Logarithms
d. Trigonometry, right angles, sine, cosine, and tangent
e. Ratios, proportions and percents
f. Fractions and decimals usage and conversions
g. Whole number manipulation
h. Algebra
i. Metric conversion
j. Squares and square roots
k. Interpret graphic data
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-16 Identifying motor leads

PERFORMANCE STATEMENT

Identify motor leads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motors
b. Each motor winding type
c. Lead identification
d. Lead marking procedure
e. Lead connection of each
f. Line connection of each
g. Motor voltage of each

Provide Demonstration On:

a. Motor winding types
b. Single volts motors
c. Dual volts motor
d. Three phase dual volts motor

Provide Practical Application On:

a. Lead identification of single phase motors
b. Lead identification of three phase motors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Rosenberg, Electric Motor Repair
b. Veinott, Fractional and Subfractional Horsepower Electric Motors

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Shop tools
b. Power supplies
c. Meter VOM
d. AC amp meter
e. Power supplies
f. One phase single volts motor
g. One phase dual volt motor
h. Three phase Delta wound motor
i. Three phase Wye wound motor
j. Strobotach

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a single phase induction motor with four unmarked leads, a single phase induction motor with six unmarked leads and three phase Wye or Delta wound induction motor with nine unmarked leads, necessary test equipment and power supplies, the student will correctly identify the leads of each motor and make the correct motor lead connection. Wiring connection to the proper power supply must be accurate. The student will operate the motor and check for proper rpm.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to use test equipment properly.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Make predictions, generalizations and comparisons
c. Draw conclusions
d. Recognize relevance of data
e. Recognize appropriate reference resources
f. Locate information in reference materials

Math Skills

a. Scientific and engineering notation
b. Law of exponents
c. Logarithms
d. Trigonometry, right angles, sine, cosine, and tangent
e. Ratios, proportions and percents
f. Fractions and decimals usage and conversions
g. Whole number manipulation
h. Algebra
i. Metric conversion
j. Squares and square roots
k. Interpret graphic data

Problem Solving Skills

a. Recognize main ideas, details, sequence of events, and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Recognize relevance of data
f. Interpret graphic data

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-17 Operating a capacitor start motor

PERFORMANCE STATEMENT

Operate a capacitor start motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor capacitor
b. Motor nameplate
c. Motor operation and winding
d. Torque characteristics
e. Load characteristics

Provide Demonstration On:

How to operate, hook up and calculate the load characteristics of capacitor motors

Provide Practical Application On:

a. Determing starting characteristics of a capacitor start motor
b. Determing load characteristics of a capacitor motor
c. Determing torque characteristics of a capacitor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft, Carr and Watt, American Electrician Handbook
b. Rosenberg, Electric Motor Repair
c. Veinott, Fractional and Subfractional Horsepower Electric Motors

A/Vs:

AAVIM, "How Electric Motors Start and Run" (ST)

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Shop tools
b. Meters AC volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supply
f. Motor loads

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a capacitor start motor and the necessary test equipment and power supplies, the student will operate, hook up and calculate the load characteristics of a capacitor start motor. Use national and local code standards for comparison.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to check motor characteristics such as: torque, start amps, full load amps, speed and efficiency.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Draw conclusions
b. Interpret graphic information
c. Recognize relevance of data
d. Recognize appropriate reference resources
e. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Fractions and decimals usage and conversions
c. Whole number manipulation
d. Algebra
e. Metric conversion
f. Squares and square roots
g. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

IE-18 Operating a three phase induction motor

PERFORMANCE STATEMENT

Operate a three phase induction motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate information
b. Three phase induction
c. Three phase power
d. Forward and reverse operation
e. Load characteristic
f. Start characteristic
g. Run characteristic
h. Motor efficiency
i. Applications

Provide Demonstration On:

Hooking up and operating a three phase induction motor

Provide Practical Application On:

a. Forward and reverse operation
b. Applications
c. Dual volts motors
d. Starting characteristic and direction of rotation
e. Torque characteristic of three phase induction motors
f. Load characteristic of three phase induction motros
g. Efficiency of a three phase induction motor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Adams, Electrical Principles and Practices
b. Rosenberg, Electric Motor Repair
c. Veinott, Fractional and Subfractional Horsepower Electric Motors

Student Manuals:

Oklahoma, Introduction to Industrial Electricity/Electronics

Tools and Equipment:

a. Shop tools
b. Motor and equipment
c. Meters AC volt-amp-watt
d. Motor standards
e. Power supply
f. Motor load

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a three phase induction motor, the necessary test equipment and power supply, the student will hook up, operate and check the following motor characteristics: torque, start amps, full load amps, speed and efficiency. Use national and local code standards for comparisons.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to calculate the load characteristics of a three phase induction motor.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Draw conclusions
b. Interpret graphic information
c. Recognize relevance of data
d. Recognize appropriate reference resources
e. Locate information in reference materials

Math Skills
a. Trigonometry, right angles, sine, cosine, and tangent
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Algebra
f. Metric conversion
g. Squares and square roots
h. Interpret graphic data

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Recognize relevance of data
e. Interpret graphic data

Communication Skills
a. Organize information
b. Interpret aural communications
c. Compose oral directions and questions
d. Use formal and informal speaking style

TASK OR UNIT COMPETENCY

HP-01 Selecting reservoirs used in hydraulic systems

PERFORMANCE STATEMENT

Select reservoirs used in hydraulic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of reservoirs
b. Purpose of reservoir
c. Operation of a reservoir
d. Reservoir construction
e. Reservoir sizing

Provide Demonstration On:

a. Vented reservoir
b. Pressurized reservoir and safety

Provide Practical Application On:

Selecting a reservoir for a hydraulic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulic Manual

A/Vs:

a. MAVCC, "Hydraulics" (TR)
b. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Reservoirs
b. Hydraulic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 2

Performance Objective (CRM)

Given specifications, tools and a hydraulic system which requires a reservoir, the student will select, with 100% accuracy, the type and construction features of a reservoir for the system.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the operation of a hydraulic reservoir.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Whole number manipulation
c. Apply formulas
d. Estimate numbers
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons
Communication Skills
a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-02 Selecting and installing lines, fittings and couplers used in hydraulic and pneumatic systems

PERFORMANCE STATEMENT

Select and install lines, fittings and couplers used in hydraulic/pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of lines, fittings, quick disconnects and couplers
b. Operation of lines, fittings, quick disconnects and couplers
c. Types of lines, fittings, quick disconnects and couplers
d. Line, fitting, quick disconnect and coupler construction

Provide Demonstration On:

Calculating flow and velocity

Provide Practical Application On:

a. Selecting lines, fittings, quick disconnects and couplers for a hydraulic/pneumatic system
b. Installing lines, fittings, quick disconnects and couplers on a hydraulic/pneumatic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power; Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Types of lines, fittings and couplers
b. Hydraulic/pneumatic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given specifications, tools and hydraulic/pneumatic system which requires fittings and couplers, the student will select, with 100% accuracy, the appropriate lines, fittings, quick disconnects and couplers for the system. The student will then install the lines, fittings and couplers. No leaks must be present.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the purpose and operation of lines, fittings, quick disconnects and couplers.

b. Students should perform an operational check of the lines, fittings, quick disconnects and couplers.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Whole number manipulation
d. Apply formulas
e. Estimate numbers

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-03 Selecting and installing seals used in hydraulic/pneumatic systems

PERFORMANCE STATEMENT

Select and install seals used in hydraulic/pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of seals
b. Operation of seals
c. Types of seals
d. Seal construction
e. Installation procedures

Provide Demonstration On:

a. Positive seals
b. Non-positive seals

Provide Practical Application On:

a. Selecting seals
b. Installing different types of seals

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power; Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Types of seals
b. Hydraulic/pneumatic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given specifications, tools and a hydraulic/pneumatic system which requires seals, the student will select, with 100% accuracy, the appropriate seals for the system. The student will then install the seals. No leaks must be present.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the purpose and operation of different types of seals.

b. Students should perform an operational check of the seals.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Apply formulas
Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Make predictions, generalizations and comparisons
Communication Skills
a. Interpret aural communications
b. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-04 Selecting and installing pumps used on hydraulic systems

PERFORMANCE STATEMENT

Select and install pumps used on hydraulic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of pumps
b. Operation of pumps
c. Types of pumps
d. Pump construction
e. Pump ratings
f. Installation procedures

Provide Demonstration On:

a. Gear pumps
b. Vane pumps
c. Piston pumps

Provide Practical Application On:

a. Selecting pumps
b. Installing different types of pumps

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Types of pumps
b. Hydraulic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a hydraulic system, tools and manufacturer's specifications, the student will select and install a pump for the system. The installation must be in accordance with the manufacturer's specifications and without leaks.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the operation of hydraulic pumps.

b. Students should perform an operational check of the pump.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Apply formulas
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predicitons, generalizations and comparisons

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-05 Identifying and describing the properties of different hydraulic fluids

PERFORMANCE STATEMENT

Identify and describe the properties of different types of hydraulic fluids.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of fluids
b. Physical and chemical properties of hydraulic fluids
c. Component protection and system contamination
    1. Water and demulsification
    2. Dissolved air
    3. Foaming
    4. Corrosion and rust
    5. Metal particles
d. Types of hydraulic fluids
    1. Petroleum oils
    2. Oil in water emulsion
    3. Water in oil emulsion
    4. Water bas glycols
    5. Chlorinated hydrocarbons
    6. Phosphate esters
    7. Silicons
    8. Silicate esters
e. Selection of fluids
f. Filling the system

Provide Demonstration On:

Different types of hydraulic fluids

Provide Practical Application On:

a. Selecting fluids for a hydraulic system
b. Filling the hydraulic system with fluid

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulic Manual

A/Vs:

a. MAVCC, "Hydraulics" (TR)
b. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Type of hydraulic fluids
b. Hydraulic systems trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 5

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given several types of hydraulic fluids, the student will identify the different types with 100% accuracy and fill the system with fluid according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to explain the properties of the different types of fluids.

b. Students should perform an operational check of the fluid.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Apply formulas

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Communication Skills

a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-06 Preventing hydraulic and pneumatic system contamination

PERFORMANCE STATEMENT

Prevent hydraulic and pneumatic system contamination.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sources of contamination in a hydraulic or pneumatic system
b. Effect of temperature, moisture and air pressure
c. Results of contamination
d. Moisture removal
e. Oil scrubbers
f. Filters
g. Procedures to avoid system contamination
h. Lubricators for pneumatic systems

Provide Demonstration On:

a. Identifying methods of filtration and decontamination
b. Procedures to avoid system contamination

Provide Practical Application On:

Identifying methods of filtration and decontamination

1. Selecting filters for a hydraulic system
2. Selecting filters for a pneumatic system
3. Installing filters in a hydraulic system
4. Installing filters in a pneumatic system
5. Operation of lubrication

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Filters
b. Strainers
c. Hydraulic system trainer
d. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given specifications, the student will explain the sources and effects of hydraulic and pneumatic system contamination and will identify the different methods of system decontamination as well as procedures to avoid system contamination.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the operation of hydraulic and pneumatic filters and strainers.

b. Students should perform an operational check of the filters, lubricators and strainers.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Make predictions, generalizations and comparisons

Communication Skills
a. Interpret aural communications
b. Compose oral directions and questions
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-07 Selecting and installing cylinders used in hydraulic/pneumatic systems

PERFORMANCE STATEMENT

Select and install cylinders used in hydraulic/pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of cylinders
b. Operation of cylinder
c. Sizing
d. Cylinder construction
e. Cylinder mountings
f. Cylinder ratings
g. Installation procedures

Provide Demonstration On:

a. Double-acting cylinders
b. Single-acting cylinders

Provide Practical Application On:

a. Selecting a cylinder for a hydraulic/pneumatic system
b. Installing a cylinder on a hydraulic/pneumatic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power; Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. MAVCC, "Hydraulics" (TR)
b. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

a. Cylinders
b. Hydraulic/pneumatic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 6

ESTIMATED LAB HOURS 8

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given specifications, tools and a hydraulic/pneumatic system which requires a cylinder, the student will select, with 100% accuracy, the type and capacity cylinder for the system. The student will then install the cylinder. The installation must be in accordance with the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the operation of a hydraulic/pneumatic cylinder.

b. Students should be given a performance test to assess their ability to calculate the following:
   1. Force output of a cylinder
   2. Speed of a cylinder
   3. Power output of a cylinder
   4. Flow rate required to move a cylinder a given distance in a given time.

c. Students should determine if internal leaks are present.

d. Students should perform an operational check of the cylinder.

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Squares and square roots
f. Apply formulas

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills
- a. Recognize main ideas, details, sequence of events and cause and effect relationships
- b. Recognize appropriate reference sources
- c. Locate information in reference materials
- d. Estimate outcomes
- e. Draw conclusions
- f. Interpret non-graphic information
- g. Recognize relevance of data
- h. Make predictions, generalizations and comparisons

Communication Skills
- a. Organize information
- b. Interpret aural communication
- c. Compose oral directions and questions
- d. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-08 Selecting and installing valves on hydraulic/pneumatic systems

PERFORMANCE STATEMENT

Select and install valves on hydraulic/pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of valves
b. Operation of valves
c. Types of valves
d. Valve construction
e. Installation procedures

Provide Demonstration On:

a. Pressure relief valves
b. Directional control valves
c. Flow control valves
d. Pressure reducting valves
e. Check valves
f. Sequence valves

Provide Practical Application On:

a. Selecting valves
b. Installing valves on hydraulic/pneumatic systems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power; Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraylics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR)(ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Valves
b. Hydraulic/pneumatic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given hydraulic/pneumatic sytems, tools and manufacturer's specifications, the student will select, with 100% accuracy, the type of valves needed for the system. The student will install the valve in accordance with the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to discuss the operation of hydraulic/pneumatic valves.

b. Students should perform an operational check of the valve.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills
a. Interpret aural communication
b. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-09 Identifying basic hydraulic/pneumatic circuits

PERFORMANCE STATEMENT

Identify basic hydraulic/pneumatic circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of basic hydraulic/pneumatic circuits
b. Types of hydraulic/pneumatic circuits
c. Oil flow in a circuit
d. Direction of fluid flow in an open circuit
e. Direction of fluid flow in multiple actuator open-center systems
f. Valves in the neutral and shifted positions in the fluid flow in a closed-center system

Provide Demonstration On:

Hydraulic/pneumatic circuits

Provide Practical Application On:

Showing the oil flow in a circuit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Pippenger and Hicks, Industrial Hydraulics
d. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Types of accessories
b. Hydraulic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 4

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a schematic of an open-center and a closed-center circuit, the student will show the oil flow in the circuit with 100% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to draw a schematic of open-center and closed-center circuits.

b. Use the resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret graphic information
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Ratios, proportions and percents
b. Whole number manipulation
c. Organize data into graphics
d. Interpret graphic data

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Organize data into graphics
i. Interpret graphic data
j. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Compose oral directions and questions

TASK OR UNIT COMPETENCY

HP-10 Selecting and installing compressors used on a pneumatic system

PERFORMANCE STATEMENT

Select and install compressors used on a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of compressor
b. Operation of compressor
c. Types of compressors
d. Compressor construction

Provide Demonstration On:

a. Displacement compressors
b. Dynamic compressors

Provide Practical Application On:

a. Distinguishing between types of compressors
b. Explaining compressor operation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, *Hydraulics*
c. Parker/Hannifin, *Industrial Pneumatic Technology*

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, *Hydraulics*

Tools and Equipment

a. Compressors
b. Pneumatic system
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a compressor, students should perform an operational check. The compressor must function according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should perform an operational check of the compressor.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize appropriate reference sources
b. Locate information in reference materials
c. Draw conclusions
d. Interpret non-graphic information
e. Recognize relevance of data
f. Make predictions, generalizations and comparisons

TASK OR UNIT COMPETENCY

HP-11 Selecting and installing motors used in hydraulic/pneumatic systems

PERFORMANCE STATEMENT

Select and install motors used in hydraulic/pneumatic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of motors
b. Operation of motors
c. Types of motors
d. Motor ratings
    1. Displacement
    2. Torque
    3. Pressure
e. Motor construction
f. Installation procedures

Provide Demonstration On:

a. Gear motors
b. Vane motors
c. Axial piston motors

Provide Practical Application On:

a. Selecting a motor for a hydraulic/pneumatic system
b. Installing a motor on a hydraulic/pneumatic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's Manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power: Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Motors
b. Hydraulic/pneumatic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 3

ESTIMATED LAB HOURS 6

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a hydraulic/pneumatic system, tools and manufacturer's specifications, the student will install the motor in the sytem. The installation must be in accordance with the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the operation of hydraulic/pneumatic motors.

b. Students should be given a performance test to assess their ability to calculate the following:
   1. Motor torque load
   2. Displacement of motor
   3. Speed of motor
   4. Motor inlet pressure
   5. Motor input and output power
   6. Motor overall efficiency

c. Students should perform an operational check of the motor.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Draw conclusions
d. Interpret instructions
e. Recognize relevance of data
f. Recognize appropriate reference resources
g. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Apply formulas

Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships

Performance Objective (CRM)

Suggested Testing Activities And Resources

b. Locate information in reference materials
c. Draw conclusions
d. Interpret non-graphic information
e. Recognize relevance of data
f. Make predicitons, generalizaitons and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-12 Selecting and installing accessories used on a pneumatic system

PERFORMANCE STATEMENT

Select and install accessories used on on a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of accessories
b. Operation of accessories
c. Types of accessories
d. Installation procedures

Provide Demonstration On:

a. Pressure switches
b. Instruments
    1. Gauges
    2. Flow meter
c. Heat exchangers

Provide Practical Application On:

a. Selecting accessories
b. Installing, setting and reading accessories on a pneumatic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power; Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics

A/Vs:

a. Bobbs - Merrill, "Fluid Power" (TR)
b. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:
a. Types of accessories
b. Pneumatic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a pneumatic system, tools and manufacturer's specifications, the student will select, with 100% accuracy, the types of accessories for the system. The student will then install the accessories according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the prupose and operation of accessories.

b. Students should be given a performance test to assess their ability to read a flow meter.

c. Students should perform an operational check of the accessories.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationskips
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret graphic information
f. Interpret instructions
g. Recognize relevance of data
h. Recognize appropriate reference resources
i. Locate information in reference materials

Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
e. Interpret graphic data
f. Estimate numbers (results)

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Suggested Testing Activities And Resources

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Interpret aural communications
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-13 Selecting and installing accessories used on a hydraulic system

PERFORMANCE STATEMENT

Select and install accessories on a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of accessories
b. Operation of accessories
c. Types of accessories
d. Installation procedures

Provide Demonstration On:

a. Accumulators
b. Intensifiers
c. Pressure switches
d. Instruments
    1. Gauges
    2. Flow meter
3. Heat exchangers

Provide Practical Application On:

a. Selecting accessories
b. Installing accessories on a hydraulic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manaul
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

A/Vs:

a. Bobbs - Merrill, "Fluid Power (TR)
b. MAVCC, "Hydraulics" (TR)
c. Parker/Hannifin, "Fluid Power" (TR) (ST)

Student Manuals:

MAVCC, Hydraulics

Tools and Equipment:

a. Types of accessories
b. Hydraulic system trainer
c. Hand tools

ESTIMATED CLASS HOURS 2

ESTIMATED LAB HOURS 3

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a hydraulic system, tools and manufacturer's specifications, the student will select, with 100% accuracy, the type of accessories for the system. The student will then install the accessories according to the manufacturer's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to discuss the purpose and operation of accessories.

b. Students should perform an operational check of the accessories.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials
Math Skills
a. Scientific and engineering notation
b. Ratios, proportions and percents
c. Fractions and decimals usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Draw conclusions
e. Interpret non-graphic information
f. Recognize relevance of data
g. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Interpret aural communications
c. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

HP-14 Planning the maintenance of a hydraulic system

PERFORMANCE STATEMENT

Plan the maintenance of a hydraulic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reasons for maintenance
b. Maintenance steps
c. Classifying maintenance
    1. Service
    2. Inspection
    3. Repair
    4. Testing
d. Inspection
e. Organizing the maintenance
    1. Identifying each system
    2. Keeping a file for maintenance records
f. Maintenance requirements
g. Regular inspections
h. Reservoir fluid level
i. Reservoir fluid temperature
j. External leaks
k. External condition of system
l. Operating pressure
m. Fluid quality

(continued on next page)

Provide Demonstration On:

Developing a maintenance plan for a hydraulic system

Provide Practical Application On:

a. Performing general maintenance procedures on a hydraulic system
b. Eliminating leaks

INSTRUCTIONAL MATERIALS

Textbooks:

a. MAVCC, Hydraulics
b. Parker/Hannifin, Fluid Power
c. Pippenger and Hicks, Industrial Hydraulics
d. Vickers, Industrial Hydraulics Manual

Student Manuals:

MAVCC, Hydraulics

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 1

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

n. Filters
o. Machine performance
p. Repair planning
q. System servicing

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a hydraulic system, the student will plan a maintenance schedule which includes inspection, servicing and overhauling. The maintenance plan must meet the instructor's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to change hydraulic fluid and filters.

b. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills

a. Determine probabilities

Problem Solving Skills

a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills

a. Organize information
b. Compose oral directions and questions

TASK OR UNIT COMPETENCY

HP-15 Planning the maintenance of a pneumatic system

PERFORMANCE STATEMENT

Plan the maintenance of a pneumatic system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Planning maintenance
   1. Lubrication
   2. Adjustment
   3. Preventive maintenance
b. Compressor room maintenance
   1. Compressor load
   2. Intake air filter
   3. Crankcase oil level
   4. Belts or belt driven units
c. System maintenance
   1. Drains and moisture traps
   2. Filters and separations
   3. Air pressure
d. Control system maintenance
   1. Shutting off the system for maintenance
   2. Regulators
   3. Cylinders
e. Keeping a maintenance log

Provide Demonstration On:

Developing a maintenance plan for a pneumatic system

Provide Practical Application On:

Performing general maintenance procedures on a pneumatic system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's manual
b. MAVCC, Hydraulics
c. Parker/Hannifin, Fluid Power; Industrial Pneumatic Technology
d. Pippenger and Hicks, Industrial Hydraulics
e. Vickers, Industrial Hydraulics Manual

ESTIMATED CLASS HOURS 4

ESTIMATED LAB HOURS 1

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a pneumatic system, the student will plan a schedule for maintaining the pneumatic system. The plan must meet the instructor's specifications.

Suggested Testing Activities And Resources

a. Students should be given a performance test to assess their ability to maintain the compressor.

b. Students should perform an operational check of belt driven units on the compressor.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Follow directions
c. Make predictions, generalizations and comparisons
d. Draw conclusions
e. Interpret instructions
f. Recognize relevance of data
g. Recognize appropriate reference resources
h. Locate information in reference materials

Math Skills
a. Determine probabilities
b. Interpret graphic data

Problem Solving
a. Recognize main ideas, details, sequence of events and cause and effect relationships
b. Recognize appropriate reference sources
c. Locate information in reference materials
d. Estimate outcomes
e. Draw conclusions
f. Interpret non-graphic information
g. Recognize relevance of data
h. Make predictions, generalizations and comparisons

Communication Skills
a. Organize information
b. Compose oral directions and questions

TASK OR UNIT COMPETENCY

C-01 Understanding computer arithmetic

PERFORMANCE STATEMENT

Understand computer arithmetic.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Adding binary numbers
b. Subtracting binary numbers
c. Multiplying binary numbers
d. Dividing binary numbers
e. Deriving the one's complement of a binary number
f. Deriving the two's complement of a binary number
g. Adding binary numbers using two's complement
h. Manipulating binary numbers using the AND operation
i. Manipulating binary numbers using the OR operation
j. Manipulating binary numbers using the EXCLUSIVE OR operation
k. Logically inverting binary numbers

Provide Demonstration On:

a. Arithmetic instructions on a microprocessor trainer
b. Logic instructions on a microprocessor trainer

Provide Practical Application On:

a. Manipulating binary numbers
b. Arithmetic instructions to a microprocessor trainer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Gilmore, Introduction to Microprocessors
b. Intel Co., Mcs-80/85 Family User's Manual
c. Tokheim, Digital Electronics

Tools and Equipment:

a. Microprocessor trainer
b. Calculator

ESTIMATED CLASS HOURS 5

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given computer arithmetic problems, the student will solve the problems with 80% accuracy.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of computer arithmetic.

b. Use resources provided in the Instructional Materials section on the previous page.

Math Skills
a. Organize data into tables, charts, and graphs
b. Whole number manipulation
c. Manipulate binary numbers
Problem Solving Skills
a. Reconize sequence of events, cause effect relationships
b. Draw conclusions

TASK OR UNIT COMPETENCY

C-02 Understanding microprocessor hardware

PERFORMANCE STATEMENT

Understand microprocessor hardware.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Memory systems
  1. Core memory
  2. Semi-conductor RAM
  3. Register concept
  4. Ram specifications
  5. Static TAM
  6. Dynamic MOS memory
  7. ROMs
  8. Shift register memory

b. Interfacing
  1. Bidirectional bus drivers
  2. Data communications line drivers and receivers
  3. Baud rate
  5. Level translators
  5. Serial and parallel

c. Hardware
  1. Bus system
  2. Input and output ports
  3. Memory hierarchy
  5. The CPU

(continued on next page)

Provide Demonstration On:

a. Identifying functions of the various sections of a microprocessor
b. Determining RAM memory size, type of addressing used, number of I/O ports, and clock speed
c. Designing assembly-language programs

Provide Practical Application On:

a. Using intergrated circuits to design a full adder
b. Using integrated circuits to design a pulse stretcher
c. Constructing an analog-to-digital converter
d. Contructing a RAM circuit and analyzing its operation
e. Constructing a 4 bit serial-in parallel-out shift-right-register.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Goody, The Intelligent Microcomputer
b. Intel Co., Mcs-80/85 Family User's Manual
c. Mano, Digital Logic and Computer Design
d. Tocci, Digital Systems: Principles and Applications

Tools and Equipment:

a. Microprocessor
b. Integrated circuit components
c. Peripheral device
d. Interface card
e. Interface cable

ESTIMATED CLASS HOURS 15

ESTIMATED LAB HOURS 10

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

d. Processing action
    1. Program processing
    2. Timing and multiplexing

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a microprocessor, the student will identify the individual pieces of hardware and describe their operation 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of microprocessor components and operation.

b. Students should be given a performance test to assess their ability to use integrated circuits to construct simple microprocessor components.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organizes data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

C-03 Understanding the functions of a computer

PERFORMANCE STATEMENT

Understand the functions of a computer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Typical computer systems
    1. Central processor unit (CPU)
    2. Memory
    3. Input/output ports (I/O)
b. Architecture of a CPU
    1. Accumulator
    2. Program counter
    3. Instruction register and decoder
    4. Address register
    5. Arithmetic/logic unit (ALU)
    6. Control circuitry
c. Computer operations
    1. Timing
    2. Instruction fetch
    3. Memory read
    4. Memory write
    5. Wait
    6. Input/output
    7. Interrupts
    8. Hold

Provide Demonstration On:

a. Central processor unit
b. Memory
c. Input/output
d. Addressing modes
e. Timing
f. Instructions

Provide Practical Application On:

a. Instructions to CPU
b. Storing data in memory
c. Setting memory size and locations
d. Activating I/O port
e. Charting the flow of data through the computer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Intel Co., Mcs-80/85 Family User's Manual
b. Reddit & Associates, Microcomputer Fundamentals, 8080 Microcomputers

Tools and Equipment:

a. Microcomputer
    1. 8 bit microcomputer
    2. 16 bit microcomputer
b. Peripheral device
c. Interface cable

ESTIMATED CLASS HOURS 20

ESTIMATED LAB HOURS 15

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given data, the student will chart the flow of data through a computer 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of computer operation and data routing.

b. Students should be given a performance test to assess their ability to use a microcomputer.

c. Students should be given a written test to assess their knowledge of computer math and language.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events cause effect relationships
b. Locate information in reference material
c. Draw conclusions
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

C-04 Using the microcomputer

PERFORMANCE STATEMENT

Use the microcomputer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Numbering systems
   1. Decimal numbers
   2. Binary numbers
   3. Octal numbers
   4. Hexadecimal numbers
   5. BCA codes
b. Computer codes
   1. BCD codes
   2. ASCII codes
   3. BAUDOT codes
c. Computer terminology
d. Purpose of a computer circuit
   1. Accumulator
   2. Program counter
   3. Instruction decoder
   4. Controller sequencer
e. Block diagram
f. Addressing modes
g. Computer language
h. Flowcharting
i. Branching

Provide Demonstration On:

a. Developing flowcharting
b. Branching programs
c. Block diagraming
d. Addressing modes
e. Writing subroutines

Provide Practical Application On:

a. Programing in various computer languages
b. Storing data in memory
c. Setting memory size and locations
d. Activating I/O port

INSTRUCTIONAL MATERIALS

Textbooks:

a. Intel Co., Mcs-80/85 Family User's Manual
b. Reddit & Associates, Microcomputer Fundamentals, 8080 Microcomputers
c. William, Z-80 Microcomputer Design Projects

Tools and Equipment:

a. Microcomputer
   1. 8 bit microcomputer
   2. 16 bit microcomputer
b. Peripheral device
c. Interface cable

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 15

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a microcomputer, the student will write programs and operate the microcomputer 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of microcomputer operation.

b. Students should be given a performance test to assess their ability to use a microcomputer.

c. Students should be given a written test to assess their knowledge of computer math and language.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

C-05 Analyzing microcomputer circuits

PERFORMANCE STATEMENT

Analyze microcomputer circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Introduction to digital techniques
   1. Number system
   2. Logic symbols and gates
   3. Basic boollean operation
   4. Laws and theorems

b. Integrated logic circuits
   1. Types, classification, and identification
   2. Parameters and characteristics
   3. Logic families
   4. Decision making logic elements

c. Flip-flops and registers
   1. D-type
   2. T-type
   3. JK
   4. Registers

d. Sequential logic circuits
   1. Counters
   2. Clocks and one shots

e. Combination logic circuits
   1. Encoders and decoders
   2. Multiplexers, code converters

f. Memory circuits

Provide Demonstration On:

a. AND, OR, NAND, and NOR IC chips
b. Flip-flops
c. Counters
d. Timers
e. Adders, subtractors, and dividers

Provide Practical Application On:

a. Connecting various gates to produce combinational logic circuits
b. Troubleshooting and repairing basic logic and digital circuits
c. Diagraming a basic logic system from a problem statement

INSTRUCTIONAL MATERIALS

Textbooks:

a. Heathkit, Digital Techniques
b. Intel Co., Mcs-80/85 Family User's Manual
c. Reddit & Associates, Microcomputer Fundamentals, 8080 Microcomputers
d. William, Z-80 Microcomputer Design Projects
e. Williams, Digital Technology

Tools and Equipment:

a. Microcomputer
b. Oscilloscope
c. Voltmeter
d. Pulse generator
e. Logic probe

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 15

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a microcomputer circuit, the student will analyze the circuit and explain and repair the circuit 90% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of microcomputer circuitry operation.

b. Students should be given a performance test to assess their ability to analyze and repair circuit problems.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

NC-01 Operating programmable controllers

PERFORMANCE STATEMENT

Operate programmable controllers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Programmable controller hardware
    1. Processor and I/O modules
    2. Power supply-chassis assembly
    3. Program panels and devices
b. Basic concepts
    1. Ladder diagram/relay logic
    2. Memory allocations/addressing
    3. Sequence of operation
c. Program panels and relay
    1. Keyboard and program panels
    2. Output and branch instructions
d. Timer, counter and data manipulation
    1. Timer and counter instruction
    2. Cascading timers and counters
e. User program and editing functions
    1. Rung writing, fault response
    2. Memory use and documentation
    3. Clear memory, change program

(continued on next page)

Provide Demonstration On:

a. Identifying functions of the various sections of a programmable controller
b. Describing the three main elements involved in control by PC
c. Assigning an address to designated terminals
d. Entering various rungs using PC equipment
e. Timer and counter instructions
f. Keyboards and program panels

Provide Practical Application On:

Using a programmable controller
1. Writing programmes
2. Editing programmes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Goody, The Intelligent Microcomputer
b. Hunter, Automatic Process Control Systems, Concepts, and Hardware
c. Intel Co., Msc-80/85 Family User's Manual
d. Kuo, Automatic Control Systems

Tools and Equipment:

a. Microcomputer
b. Programmable controller
c. Peripheral device
d. Interface card
e. Interface cable

ESTIMATED CLASS HOURS 15

ESTIMATED LAB HOURS 10

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

f. Coding and documentation of PC programs
    1. Sequence, device testing and program entry and testing
    2. Simulate operation

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a programmable controller, interface equipment, and peripherals, the student will set up and operate a peripheral device 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of programmable controllers, peripheral connection and operation.

b. Students should be given a performance test to assess their ability to use programmable controllers and peripheral devices.

c. Students should be given a written test to assess their knowledge of programming programmable controllers.

d. Students should be given a performance test to assess their ability to write programs for programmable controllers.

e. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organizes data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Organize information
b. Compose sentences
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

NC-02 Operating solid state logic motor controls

PERFORMANCE STATEMENT

Operate solid state logic motor controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Concepts of static logic control
b. Identifying static logic control logic
    1. AND, OR, NOT logic functions; (solid state relay)
    2. AND-NOT, OR-NOT, and sealed/NAND functions
    3. Memory devices and adjustable time delay
c. Solid state logic motor control circuits
d. AC machine control
    1. Variable frequency speed control
    2. SCR's motor speed regulates
    3. Dynamic braking and plugging
e. DC motor control
    1. Magnetic amplifiers
    2. SCR armature control circuits
    3. Dynamic braking and plugging

(continued on next page)

Provide Demonstration On:

a. AND, OR, NOT logic functions and solid state relays
b. Memory devices and adjustable time delays
c. Solid state logic motore controls
d. Servo motor, switching amplifier, digital position error detector, closed loop positioning

Provide Practical Application On:

a. Stepper motor, motor and drive circuits
b. Stepper motor, data entry circuits
c. Memory devices and adjustable time delay
d. Three phase induction motor controller

INSTRUCTIONAL MATERIALS

Textbooks:

a. Hampden and Sellware, Lab-Volt, Static Control Training Systems, Vols. 1,3,4,5
b. Humpheries and Sheets, Industrial Electronics
c. Janson, Power Control Electronics
d. McIntyre, Electronic Motor Control Fundamentals
e. Maloney, Industrial Solid State Electronics: Devices and Systems

Tools and Equipment:

a. Electric motors, AC, DC, three phase
b. AND, OR, NAND, NOT logic elements
c. Power supply

ESTIMATED CLASS HOURS 15

ESTIMATED LAB HOURS 20

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

f. Positional control
    1. X-Y coordinate positioning control
    2. Angular positioning control

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given electric motors, solenoids and solid state logic equipment, the student will set up, run and control motors or solenoids 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of solid state logic equipment, motors and motor controls.

b. Students should be given a performance test to assess their ability to use solid state logic equipment, motors and motor controls.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret instructions
b. Locate information in reference materials
Math Skills
a. Organized data into tables, charts and graphs
b. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information inreference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. USe formal and informal speaking styles

TASK OR UNIT COMPETENCY

NC-03 Understanding instrumentation for programmable controllers

PERFORMANCE STATEMENT

Understand instrumentation for programmable controllers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Principles of process control
b. Instruments for fluid measurements, pressure and level
c. Fluid flow measurement
d. Instruments for temperature measurement
e. Instruments for mechanical measurement
f. Pneumatic controls
g. Automatic control systems

Provide Demonstration On:

a. Open and closed loop control
b. Negative feedback in the control system
c. Fail-safe conditions
d. Flow rate calculations
e. Mechanical temperature transducers
f. Transducers and transmitters
g. Motion detectors
h. Velocity measures
i. Proximity and limit detectors
j. Pneumatic transmitters

Provide Practical Application On:

a. Constructing and testing a flow level control system
b. Calibrating pressure gauges
c. Calibrating flow metering devices
d. Constructing and operating an open-loop control system
e. Measuring temperature with a thermocouple and RTD

INSTRUCTIONAL MATERIALS

Textbooks:

a. Goody, The Intelligent Microcomputer
b. Hunter, Automatic Process Control Systems, Concepts and Hardware
c. Intel Co., Mcs-80/85 Family User's Manual
d. Kuo, Automatic Control Systems

Tools and Equipment:

a. Microcomputer
b. Programmable controller
c. Peripheral device
d. Transducers and transmitters
e. Flow gauges
f. Pressure gauges
g. Limit and proximity detectors

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a programmable controller, interface equipment, instrumentation, and controls, the student will monitor and regulate computer controlled systems 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of programmable controllers, peripheral connection and operation.

b. Students should be given a written test to assess their knowledge of instrumentation and control devices.

c. Students should be given a performance test to assess their ability to use programmable controllers with instrumentation and control devices.

d. Use resources provided in the Instructional Materials section on the prvious page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organizes data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
e. Measurement, volume, weight, area, time, speed
Problem Solving Skills
a. Recognize, sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

NC-04 Interfacing a microcomputer with peripherals

PERFORMANCE STATEMENT

Interface microcomputers with peripherals.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic I/O and interfacing techniques
b. Programmable peripheral chips
c. Data communication
    1. Synchronous vs asynchronous
    2. Simplex/suplex transmission
    3. Transmission codes
    4. RS-232
d. Controllers
    1. Single-chip microcontroller
    2. Stepper motor
    3. Stepper motor interface
e. Interfacing sense devices with a microcomputer
    1. Light
    2. Sound
    3. Temperature
    4. Pressure
    5. Motion

(continued on next page)

Provide Demonstration On:

a. The use of RS-232 board
b. Programming for RS-232 output
c. Installation of interface cards
d. Transmitting data between computer and peripheral

Provide Practical Application On:

a. Using a microcomputer to control a peripheral device
b. Setting up a computer and peripheral device
c. Operating motors with a computer interface

INSTRUCTIONAL MATERIALS

Textbooks:

a. Goody, The Intelligent Microcomputer
b. Hunter, Automatic Process Control Systems, Concepts and Hardware
c. Intel Co., Mcs-80/85 Family User's Manual

Tools and Equipment:

a. Microcomputer
b. Peripheral devise
c. Interface card
d. Interface cable
e. Electrical sensing devices

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 20

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

f. Mathematical refinement
    1. Multiple-precision numbers
    2. Multiplication
    3. Positive and negative numbers

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a microcomputer and interface equipment, the student will set up a peripheral device 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of peripheral connection and operation.

b. Students should be given a performance test to assess their ability to use a computer and peripheral devices.

c. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

NC-05 Using the microcomputer as a controller

PERFORMANCE STATEMENT

Use the microcomputer as a controller.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The microcomputer as a controller
   1. Microcomputer interfacing
   2. Closed-loop control system
b. Microcomputer troubleshooting
   1. The signature and analysis
   2. The logic analysis
c. Comparison of 8 bit microcomputers
   1. Z-80 based microcomputers
   2. 6502 based microcomputers
   3. 8080 based microcomputers
   4. 6800 based microcomputers
d. The 16 bit microcomputer
   1. Comparison of the 16 bit 8 bit microcomputer
   2. 16 bit software
   3. 16 bit I/O
   4. 16 bit interfacing

Provide Demonstration On:

a. The use of RS-232 board
b. 8 bit microcomputer
c. 16 bit microcomputer
d. Microcomputer troubleshooting

Provide Practical Application On:

a. Using a microcomputer to control a peripheral device
b. Setting up a circuit using a microcomputer and transducer
c. Operating motors with a computer interface
d. Setting up a microcomputer to operate a security system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Goody, The Intelligent Microcomputer
b. Hunter, Automatic Process Control Systems, Concepts and Hardware
c. Intel Co., Mcs-80/85 Family User's Manual
d. Reddit & Associates, Microcomputer Fundamentals, 8080 Microcomputers
e. Willian, Z-80 Microcomputer Design Projects

Tools and Equipment:

a. Microcomputer
   1. 8 bit microcomputer
   2. 16 bit microcomputer
b. Peripheral device
c. Interface card
d. Interface cable
e. Electrical sensing devices
   1. Transducers
   2. Optical transducers

ESTIMATED CLASS HOURS 15

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a microcomputer and interface equipment, the student will set up a microcomputer controlled device and operate the device 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of microcomputer operation.

b. Students should be given a performance test to assess their ability to use a microcomputer.

c. Students should be given a performance test to assess their ability to use a microcomputer as a controller for other devices.

d. Use resources provided in the Instructional Materials section on the previous page.

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts and graphs
b. Whole number manipulation
c. Convert numbers to decimal, binary and hex systems
Problem Solving Skills
a. Recognize sequence of events, cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

R-01 Comparing robotic systems

PERFORMANCE STATEMENT

Compare robotic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. History and development of robots
   1. Mechanization
   2. Automation
   3. Robotization
b. Current application and distribution
c. Projection, issues and trends in the use of robots
d. State of the art research
   1. Tactile sensors
   2. CAE/CAD/CAM
   3. Collision avoidance
e. Robot applications
f. Elements of industrial robot systems
   1. Robot operating parameters
   2. Robot hardware
   3. Robotic system control
   4. Flexible manufacturing system
g. Implementing robot systems
h. Comparative robot systems
   1. Seiko 700
   2. Copperweld CR 50

(continued on next page)

Provide Demonstration On:

a. Actuator systems of typical robots (cartesian, cylindrical, spherical, articulated)
b. Hydraulic, electric and pneumatically driven robots
c. Writing simple off-line programs, loading and testing the programs at the control console
d. Various types of robots used in industry today and the capability of each system

Provide Practical Application On:

a. Identifying power sources used by industrial robots
b. Identifying various industrial tasks that robots can perform
c. Identifying actuator systems of typical industrial robots
d. Operating a robot using a controller
e. Identifying robot sensing devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Engelberger, Robotics in Practice, Management and Applications of Industrial Robots
b. Hunt, Industrial Robotics Hand Book
c. Rehg, Introduction to Robotics

Tools and Equipment:

a. Robot actuators
   1. Hydraulic, electric, pneumatic
   2. Linear, rotary, solenoid
b. Robot controller
c. Robotic sensing devices
   1. Light
   2. Heat
   3. Sound
   4. Motion
   5. Pressure

ESTIMATED CLASS HOURS 10

ESTIMATED LAB HOURS 5

TASK OR UNIT COMPETENCY

PERFORMANCE STATEMENT

INSTRUCTIONAL ACTIVITIES

Provide Information On:
(continued)

3. GMF MIA
4. Cincinnati Milacron T3/586
5. IBM 7535

INSTRUCTIONAL MATERIALS

ESTIMATED CLASS HOURS

ESTIMATED LAB HOURS

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given schematics, diagrams, and data prepared by the vendors of selected robots, the student will prepare a written report which outlines characteristics, capabilities and possible industrial uses of the robot 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of types and current uses of robots in industry.

b. Students should be given a performance test to assess their ability to identify types of robots, power systems, and actuators used in industry today.

c. Use resources provided in the Instructional Materials section on the previous page.

d. South-Western Publishing Co., The Robotics Filmstrips

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials

Math Skills
a. Organizes data into tables, charts and graphs
b. Algebra
c Decimals and fractions usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

R-02 Installing a robot

PERFORMANCE STATEMENT

Install a robot.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inspecting shipping crates
b. Running a parts inventory
c. Reviewing installation instructions and drawings
d. Estimating time required to complete work
e. Reviewing electrical codes
f. Locating subbase in accordance with plant installation drawings
g. Positioning robot in accordance with manufacturer's instructions
h. Installing electrical power
i. Placing hydraulic or pneumatic power pack
j. Connecting proper electrical and cooling lines
k. Inspecting robot and systems for proper installation and operation
l. Performing safety inspection of work site

Provide Demonstration On:

a. Installing electrical components
b. Installing hydraulic/pneumatic components
c. Preparing controllers
d. Checking for proper installation and safety
e. Scheduling maintenance of robot

Provide Practical Application On:

a. Installing robots and support equipment
b. Checking installation for compliance with state and federal codes
c. Starting up and testing of robot
d. Scheduling work assignments and maintenance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Engelberger, Robotics in Practice, Management and Applications of Industrial Robots
b. Hunt, Industrial Robotics Hand Book
c. Rehg, Introduction to Robotics

Tools and Equipment:

a. Robot operation manual
b. Tool kit
c. Electrical codes/regulations
d. Robot controller
e. Robot
f. Plant installation drawings

ESTIMATED CLASS HOURS 20

ESTIMATED LAB HOURS 20

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given tools, instructions, safety codes, and support equipment, the student will install and test a robot 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of robotic systems and maintenance requirements.

b. Students should be given a written test to assess their knowledge of proper installation and testing processes.

c. Students should be given a performance test to assess their ability to install and test robotics equipment.

d. Use resources provided in the Instructional Materials section on the previous page.

e. South-Western Publishing Co., The Robotics Filmstrips

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials

Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra.
c. Decimals and fractions usage and conversions
d. Whole number manipulation

Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons

Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

R-03 Designing a work cell

PERFORMANCE STATEMENT

Design a work cell.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Limitations of robot
    1. Reach
    2. Lifting ability (weight)
    3. Speed
    4. Accuracy
b. Estimating time required to complete work
c. Assigning priority rank to work
d. Planning materials delivery system
e. Work cell organization
    1. Specifications and tolerances
    2. Programming robots
f. Training/programming robots
    1. Programmable controllers
    2. Teaching pendant
g. Robotic systems
    1. Work cell design and set-up
    2. Synchronization of devices
    3. Maintenance schedule
    4. Work flow and material handling
    5. Quality control and inspection

Provide Demonstration On:

a. Flowcharting material through work cell
b. Determining robot capabilities
c. Matching delivery systems with robots
d. Programming a robot
e. Scheduling work assignments
f. Scheduling maintenance of robot

Provide Practical Application On:

a. Writing a simple off-line program
b. Programming a robot
c. Setting up a work cell
d. Scheduling work assignments and maintenance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Engelberger, Robotics in Practice, Management and Application of Industrial Robots
b. Hunt, Industrial Robotics Hand Book
c. Rehg, Introduction to Robotics

Tools and Equipment:

a. Robot operation manual
b. Production schedule
c. Materials inventory
d. Robot controller
e. End of arm tools
f. Robot sensing devices
g. Robot

ESTIMATED CLASS HOURS 15

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a robot, materials inventor, robot manual and robot sensing devices, the student will design a work cell for a robot 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of robotic systems.

b. Students should be given a performance test to assess their ability to design and set up a robot work cell.

c. Use resources provided in the Instructional Materials section on the previous page.

d. South-Western Publishing Co., The Robotics Filmstrips

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
e. Measurement of lengths, area, volume, weights, time
Problem Solving Skills
a. Recognize sequence of events, cause and effect relationships
b. Locate information in reference materials
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

R-04 Scheduling robot work assignments

PERFORMANCE STATEMENT

Schedule robot work assignments.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Inventory of materials
b. Inventory of tools
c. Work assignment sheets
d. Estimating time required to complete work
e. Assigning priority rank to work
f. Estimate robot work capability
g. Work cell organization
    1. Specifications and tolerances
    2. Programming robots
h. Considering types of robot training
    1. Programmable controllers
    2. Lead through and teach pendant modes
i. Robotic systems
    1. Work cell design and set-up
    2. Synchronization of devices
    3. Utilizing controllers
    4. Work flow and material handling
    5. Quality control and inspection

Provide Demonstration On:

a. Flowcharting material flow
b. Determing robot capabilities
c. Charting order of work
d. Programming a robot using lead through and teach pendant methods
e. Setting up a work cell
f. Scheduling work assignments
g. Scheduling maintenance of robots

Provide Practical Application On:

a. Writing a simple off-line program
b. Charting materials flow
c. Programming a robot
d. Setting up a work cell
e. Scheduling work assignments and maintenance

INSTRUCTIONAL MATERIALS

Textbooks:

a. Engelberger, Robotics in Practice, Management and Application of Industrial Robots
b. Hunt, Industrial Robotics Hand Book
c. Rehg, Introduction to Robotics

Tools and Equipment:

a. Robot operation manual
b. Production schedule
c. Materials inventory
d. Robot controller

ESTIMATED CLASS HOURS 15

ESTIMATED LAB HOURS 10

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given work schedules, materials inventor, robot manual and robot, the student will design a working schedule for a robotic work cell 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of robotic systems and maintenance requirements.

b. Students should be given a performance test to assess their ability to schedule materials flow and work in a robot work cell.

c. Use resources provided in the Instructional Materials section on the previous page.

d. South-Western Publishing Co., The Robotics Filmstrips

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
e. Measurement of lengths, area, volume, weights, time
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

TASK OR UNIT COMPETENCY

R-05 Repairing and maintaining robotic systems

PERFORMANCE STATEMENT

Repair and maintain robotic systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Maintenance and operation
  - 1. Hydraulic robots
  - 2. Pneumatic robots
  - 3. Electric robots
- b. Robotics problem definition
  - 1. Characteristics of specific robots
  - 2. Work cell organization
  - 3. Specifications and tolerances
- c. Programming robots
  - 1. Programmable controllers
  - 2. Lead through and teach pendant modes
- d. Robotic systems
  - 1. Work cell design and set-up
  - 2. Synchronization of devices
  - 3. Utilizing controllers
  - 4. Work flow and material handling
  - 5. Quality control and inspection
  - 6. Probelms in selecting robot types
  - 7. End of arm tooling

Provide Demonstration On:

- a. Hydraulic, electric, and pneumatic actuators of the type used on robots
- b. Writing simple off-line programs, down loading, debugging and modifying the programs
- c. Performing preventive maintenance on hydraulic, pneumatic, and electric robots
- d. Programming robot using lead through and teach pendant methods
- e. Setting up a work cell and implementing a robotic system to perform production tasks
- f. Designing a simple end of arm tool

Provide Practical Application On:

- a. Writing a simple off-line program
- b. Performing preventive maintenance
- c. Programming a robot using lead through and teach pendant methods
- d. Designing simple end of arm tool

INSTRUCTIONAL MATERIALS

Texthooks:

- a. Engelberger, Robotics in Practice, Management and Application of Industrial Robots
- b. Hunt, Industrial Robotics Hand Book
- c. Rehg, Introduction to Robotics

Tools and Equipment:

- a. Robot actuators
  - 1. Hydraulic, electric, pnaumatic
  - 2. Linear, rotary, solenoid
- b. Robot controller
- c. Robotic sensing devices
  - 1. Light
  - 2. Heat
  - 3. Sound
  - 4. Motion
  - 5. Pressure
- d. Hydraulic, pneumatic and electric robots

ESTIMATED CLASS HOURS 20

ESTIMATED LAB HOURS 20

EVALUATION OF PERFORMANCE

Performance Objective (CRM)

Given a hydraulic, pneumatic or electric robot, the student will explain and repair mechanical or programming problems 100% of the time.

Suggested Testing Activities And Resources

a. Students should be given a written test to assess their knowledge of robotic systems and common mechanical and programming problems.

b. Students should be given a performance test to assess their ability to identify and repair common problems with robotic power systems, actuators and programmes used in industry today.

c. Use resources provided in the Instructional Materials section on the previous page.

d. South-Western Publishing Co., The Robotics Filmstrips

Reading Skills
a. Interpret graphic information
b. Interpret instructions
c. Locate information in reference materials
Math Skills
a. Organize data into tables, charts, and graphs
b. Algebra
c. Decimals and fractions usage and conversions
d. Whole number manipulation
e. Measurement of lengths, area, volume, weights, time
Problem Solving Skills
a. Recognize sequence of events, cause effect relationships
b. Locate information in reference material
c. Draw conclusions
d. Make predictions, generalizations and comparisons
Communication Skills
a. Compose sentences
b. Organize information
c. Interpret aural communications
d. Compose oral directions and questions
e. Use formal and informal speaking styles

FACILITIES

FACILITIES

Contents Listing

Facilities Introduction 3
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Learning Resource Center 9

FACILITIES INTRODUCTION

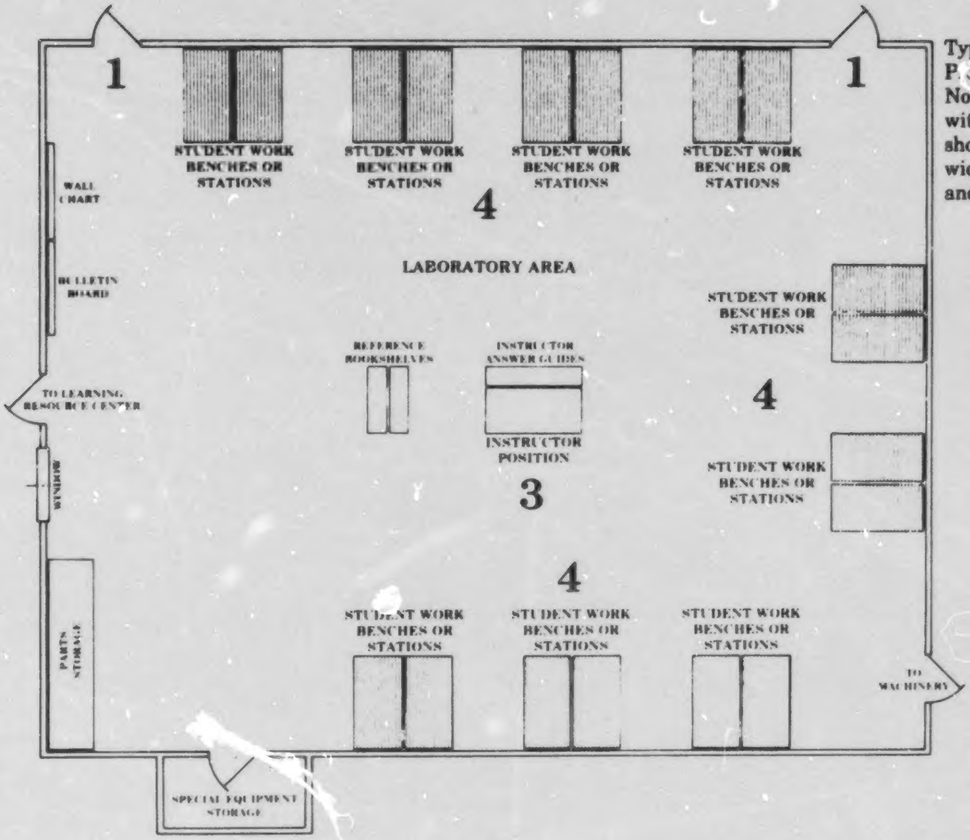
This section provides graphic and written information beneficial to setting up the student performance/work area and the learning resource center. Please note that the numbers appearing on the graphics correlate with the numbered checklist items.

FACILITIES

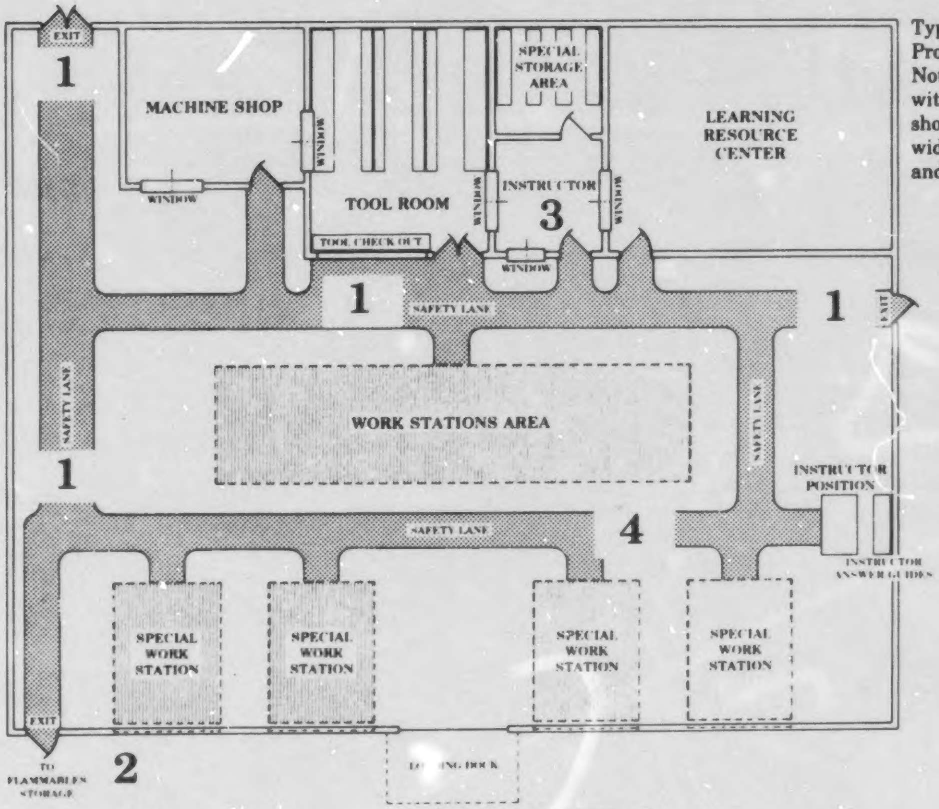
Good facility layouts attribute to program efficiency. When planning facility layouts, two key areas which require great consideration are the student performance/work area and the learning resource center (LRC). This section provides, through a checklist system, a variety of ideas beneficial to setting up both types of facilities.

STUDENT PERFORMANCE OR WORK AREA CHECKLIST

CHECKLIST	COMMENTARY
"1. Safety consideration in the work areas.	Physical dangers exist in any work area. These dangers may come in the form of physical hazards, electrical hazards, or dangers from special equipment. To protect against some of the more obvious problem areas, in shop and in lab areas, be sure to consider the following items in your planning. .Sufficient emergency exits .Proper emergency exits .Proper ventilation and exhaustion .Outlining safety lanes (particularly in shop type programs) .Surrounding hazardous areas such as pits, etc. with proper barriers or fencing (again, this pertains to shop courses where work is often done below ground level) .Use of proper safety shields on all equipment (such as grinders, saws, drill presses, and other rotating machinery) .Preventing equipment overhangs such as equipment hanging over the edges of lab benches, etc.

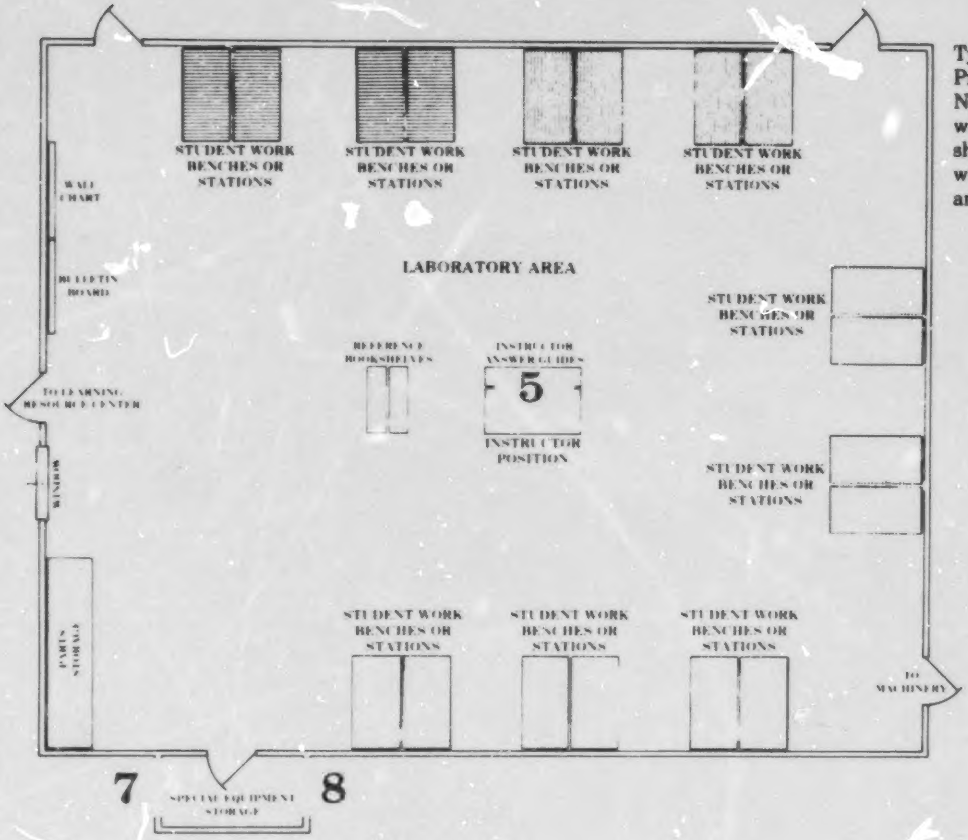

1
1
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
WALL CHART
4
LABORATORY AREA
BULLETIN BOARD
STUDENT WORK BENCHES OR STATIONS
REFERENCE BOOKSHELVES
INSTRUCTOR ANSWER GUIDES
TO LEARNING RESOURCE CENTER
4
INSTRUCTOR POSITION
WINDOW
STUDENT WORK BENCHES OR STATIONS
3
4
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
PARTS STORAGE
TO MACHINERY
SPECIAL EQUIPMENT STORAGE

Typical Lab-type Program Layout
Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.!

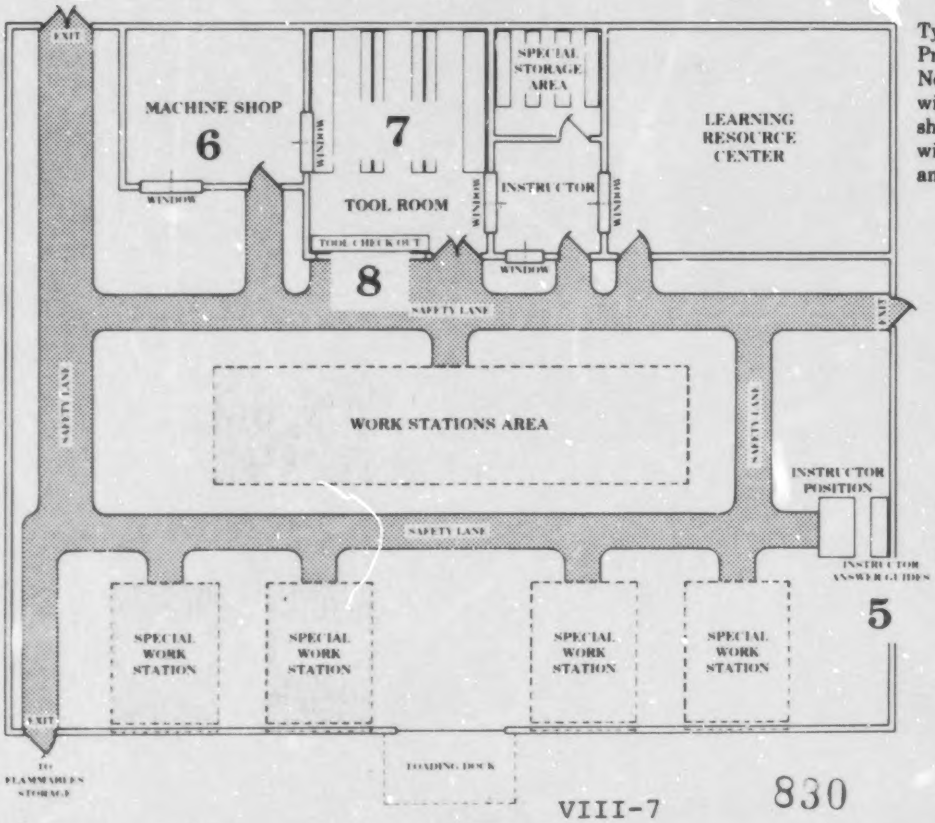

EXIT
1
MACHINE SHOP
WINDOW
WINDOW
SPECIAL STORAGE AREA
LEARNING RESOURCE CENTER
WINDOW
INSTRUCTOR
WINDOW
TOOL ROOM
3
TOOL CHECK OUT
WINDOW
1
SAFETY LANE
1
EXIT
SAFETY LANE
WORK STATIONS AREA
SAFETY LANE
1
INSTRUCTOR POSITION
SAFETY LANE
4
INSTRUCTOR ANSWER GUIDES
SPECIAL WORK STATION
SPECIAL WORK STATION
SPECIAL WORK STATION
SPECIAL WORK STATION
EXIT
TO FLAMMABLES STORAGE
2
LOADING DOCK

Typical Shop-type Program Layout
Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.!

CHECKLIST	COMMENTARY
2. Safe storage of flammables.	All flammables should be stored away from or isolated from the work area, and if possible away from the building proper.
3. Can the teacher monitor all students from the instructor's position?	In lab programs the instructor's position should be located in the center of the lab, if possible. In shop type programs, or in a situation where the instructor's position is not in the center of the work area, glass windows or viewing capability should be an integral part of the instructor station.
4. Is it easy for the instructor to circulate among the students, and is it easy for students to get to the instructor?	Not only is eye contact needed, but direct instructor-student contact is required and important! This is a key part of student morale, motivation and learning experience.
5. Does the instructor have all required information readily available?	Without well organized instructor Answer Guides for all course checkpoints, the task of checking student's work would be almost impossible. These Answer Guides should have all pertinent information for job sheets, operation sheets, oral quizzes, written tests, performance tests, etc. It is suggested that the Answer Guides be organized into notebooks with tabs (and separators) for each unit's materials. Some instructors have organized a separate theory and performance notebook for each major phase or segment of the course. In the Theory Instructor Guide, all answers


STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
WALL CHART
BULLETIN BOARD
LABORATORY AREA
STUDENT WORK BENCHES OR STATIONS
REFERENCE BOOKSHELVES
INSTRUCTOR ANSWER GUIDES
5
INSTRUCTOR POSITION
TO LEARNING RESOURCE CENTER
WINDOW
STUDENT WORK BENCHES OR STATIONS
PARTS STORAGE
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
TO MACHINERY
7
SPECIAL EQUIPMENT STORAGE
8

Typical Lab-type Program Layout
Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.!


EXIT
MACHINE SHOP
6
WINDOW
WINDOW
7
TOOL ROOM
TOOL CHECK OUT
8
SPECIAL STORAGE AREA
INSTRUCTOR
WINDOW
WINDOW
WINDOW
LEARNING RESOURCE CENTER
SAFETY LANE
EXIT
SAFETY LANE
WORK STATIONS AREA
SAFETY LANE
INSTRUCTOR POSITION
SAFETY LANE
INSTRUCTOR ANSWER GUIDES
5
SPECIAL WORK STATION
SPECIAL WORK STATION
SPECIAL WORK STATION
SPECIAL WORK STATION
EXIT
TO FLAMMABLES STORAGE
LOADING DOCK

Typical Shop-type Program Layout
Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.!

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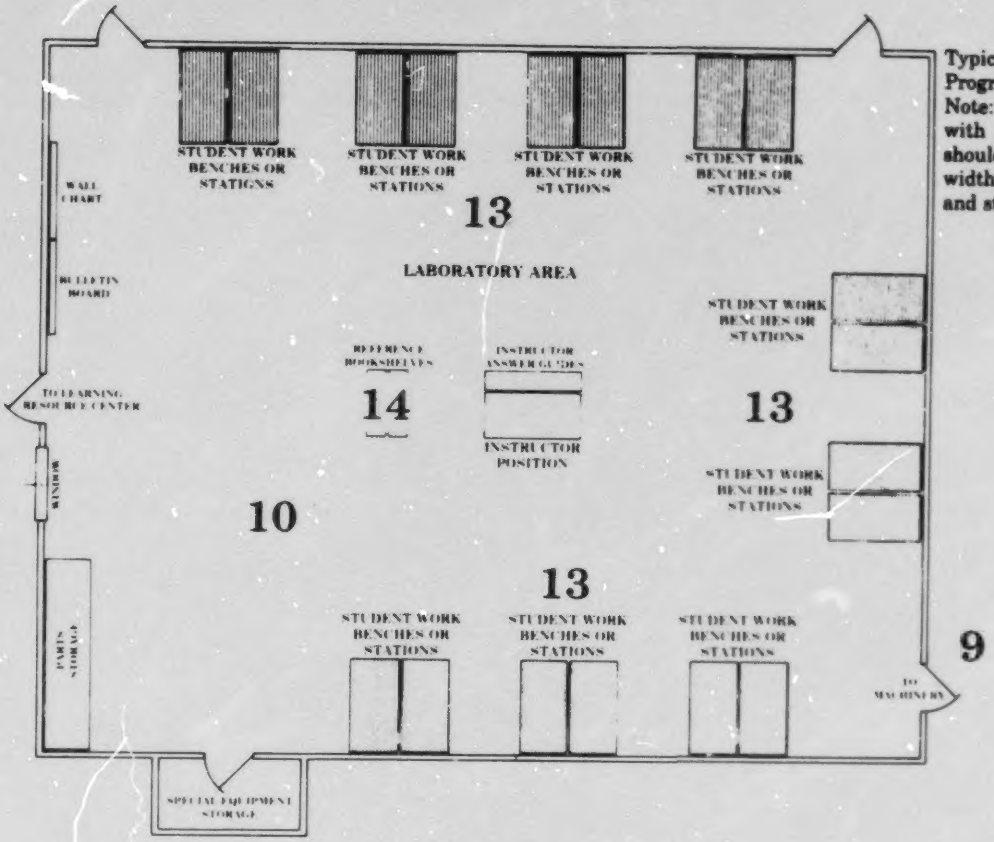
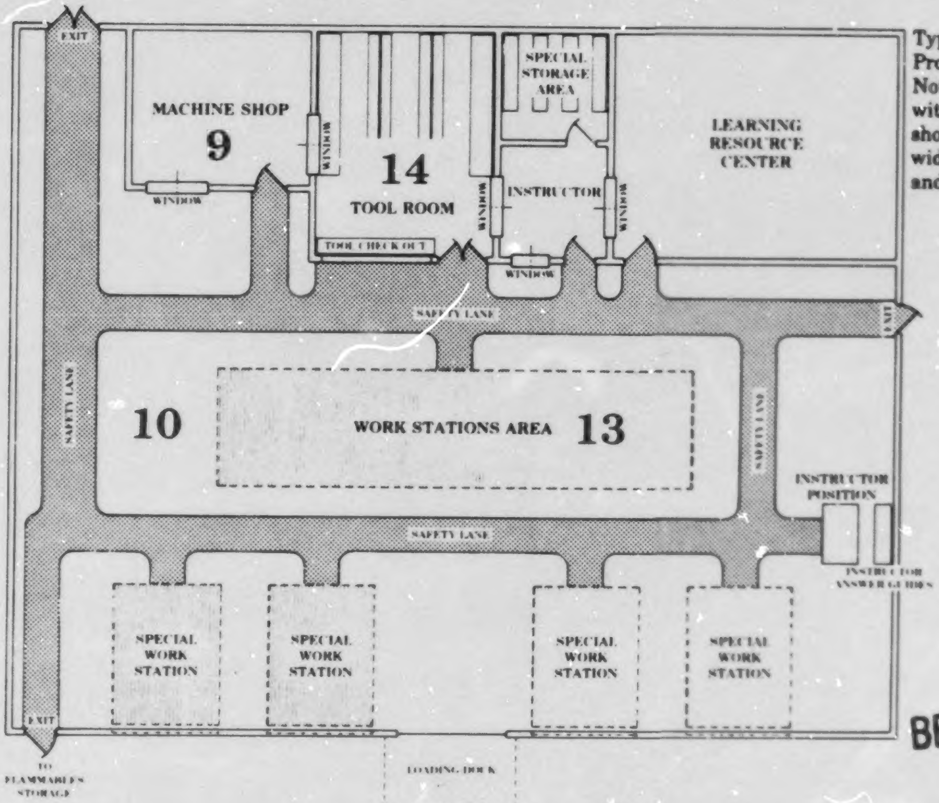
CHECKLIST	COMMENTARY
(continued) 5. Does the instructor have all required information readily available?	for tests, quizzes, etc. are given. In the Performance Instructor Guide, all pertinent information and answers for lab, operations sheets, etc. are provided. These instructor guides should literally be at the instructor's fingertips. Generally, these guides should be kept on the instructor's desk or work station.
6. Is there sufficient equipment?	Watch for either excessive equipment of one type or too few of a needed item.
7. Is there adequate storage area for equipment, tools and the like?	Insufficient storage area or lack of organization will foster inefficient and frustrating operation.
8. Is there a good check-in, check-out and inventory system for equipment and tools?	Where possible, small tool storage racks should have silhouettes of each tool behind each of the tool's storage hooks. On equipment where this is not practical, some identifier or labeling of the space where the tool is stored should be used. In this way, when a tool or piece of equipment is checked out or missing it is obvious with just a glance. Each student should have a tag which is specifically assigned to that student for checking out tools or equipment. For example, the student tags may be numbered with two digit numbers. When the student checks out a tool, the tag should be given to the


STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
WALL CHART
13
LABORATORY AREA
BULLETIN BOARD
STUDENT WORK BENCHES OR STATIONS
REFERENCE BOOKSHELVES
INSTRUCTOR ANSWER GUIDES
TO LEARNING RESOURCE CENTER
14
13
INSTRUCTOR POSITION
STUDENT WORK BENCHES OR STATIONS
WINDOW
10
13
PARTS STORAGE
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
STUDENT WORK BENCHES OR STATIONS
9
TO MACHINERY
SPECIAL EQUIPMENT STORAGE

Typical Lab-type Program Layout
Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.!


EXIT
MACHINE SHOP
9
WINDOW
WINDOW
14
TOOL ROOM
TOOL CHECK OUT
SPECIAL STORAGE AREA
INSTRUCTOR
WINDOW
WINDOW
WINDOW
LEARNING RESOURCE CENTER
SAFETY LANE
EXIT
SAFETY LANE
10
WORK STATIONS AREA
13
SAFETY LANE
INSTRUCTOR POSITION
SAFETY LANE
INSTRUCTOR ANSWER GUIDES
SPECIAL WORK STATION
SPECIAL WORK STATION
SPECIAL WORK STATION
SPECIAL WORK STATION
EXIT
TO FLAMMABLES STORAGE
LOADING DOCK

Typical Shop-type Program Layout
Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.!

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CHECKLIST	COMMENTARY
(continued) 8. Is there a good check-in, check-out and inventory system for equipment and tools?	person operating the tool crib or equipment checkout. The checkout person should then hang the student's tag on the hook or place it in the space from which the tool or equipment was removed. When the tool or equipment retrieval time arrives at the end of the day, the tags identify which students still have tools out and precisely what tool or piece of equipment the students have.
9. Are distractions and noise pollution minimized?	Extra noisy machines and machines that produce great amounts of dust and residue should be located in isolated areas as much as possible.
10. Are facilities easily cleaned?	Safe, efficient operation in any shop or lab is dependent upon a clean and organized work area. Thoughtfulness in facility planning will aid in this area.
11. Is lighting adequate?	Insufficient lighting in a shop or lab environment reduces efficiency, is a health hazard to eyesight and often creates unsafe situations. Where portable lights are needed, as in shop situations, the drop cords used for power should literally be drop cords from the ceiling, not cords strewn around the floor area.

CHECKLIST	COMMENTARY
12. Are power outlets, air outlets and the like properly located and sufficient in number?	Too few outlets often cause a situation where extension cords, hoses, etc. are laying around the shop or lab. Proper planning of facilities relative to the type of work that will be carried on at each location alleviates the condition of too few or improperly located outlets.
13. Are student work positions comfortable?	This entails everything from good lab chairs and benches for laboratory-type programs to properly equipped work stations in shop-type programs. In both situations light and ventilation also play an important role in student comfort and efficiency.
14. Can students procure needed shop manuals, equipment operating manuals, etc. easily?	All pertinent references, technical manuals and like which are needed routinely during performance of shop or lab work should be readily accessible. They should be organized for easy retrieval and inventory. (Note: Be sure to consider the special needs students with handicapping conditions when planning storage height, etc.)"[1]

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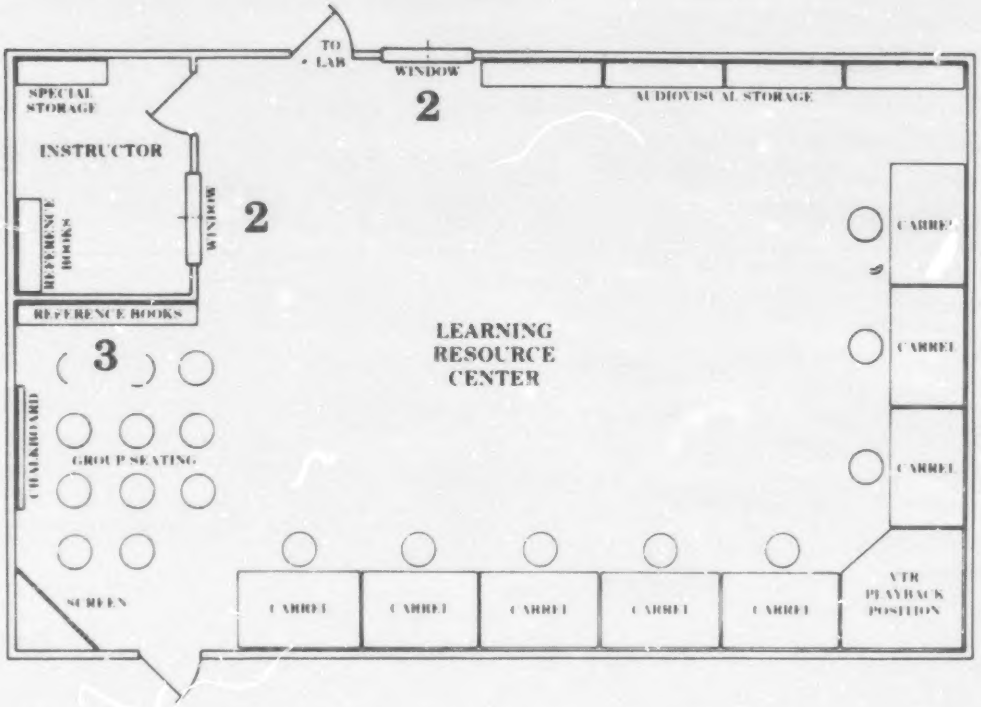
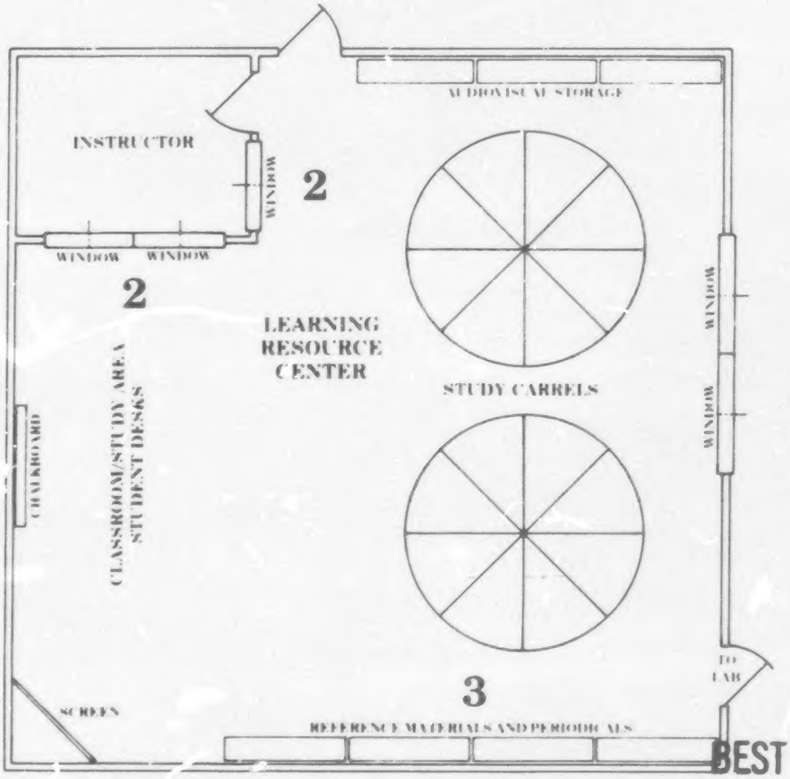
[1] Meade, Russell L. *Installing and Operating an Individualized Instruction Program*. Atlanta, GA: Georgia Department of Education, 1982.

LRC AND STUDY AREA CHECKLISTS

CHECKLIST	COMMENTARY
1. Is the study area quiet and conducive to concentration?	The quiet study area should allow the student to be isolated. Student desks and chairs, which are movable, or perhaps study carrels, which allow isolation, may be used.
2. Can the instructor adequately monitor activities in the LRC?	If the LRC is in a separate room, a frequent solution to this problem is use of glass partitions or windows between rooms or training areas.
3. Is there adequate system for storage and retrieval of printed materials used in the program? (NOTE: Can the handicapped and special needs students access the materials?)	Generally, a filing system made up of file cabinets and/or storage shelves are required to organize the training materials. Establish a numbering system to aid in check-in, check-out and inventory of items which are used repeatedly. Software which is expendable, such as unit sheets, lab projects, etc., should be filed in an organized, well labeled fashion for student procurement. Again, for books, etc. which are checked in and out, devise a system whereby books and associated storage areas are labeled and inventory can be accomplished with just a glance.
4. Is there an adequate system for storage for visuals (such as slides) and audiovisuals? (NOTE: Can the handicapped and special needs students access them?)	Audiovisual storage shelves may be specially made in the form of compartmentalized storage shelves. Standard book shelves may also be used. Use slide tray boxes for storing slide trays and reinforce the boxes with tape to make them last longer. Store the slides


TO LAB
WINDOW
2
AUDIOVISUAL STORAGE
SPECIAL STORAGE
INSTRUCTOR
REFERENCE BOOKS
WINDOW
2
CARREL
CARREL
CARREL
LEARNING RESOURCE CENTER
REFERENCE BOOKS
3
CHALKBOARD
GROUP SEATING
SCREEN
CARREL
CARREL
CARREL
CARREL
CARREL
VTR PLAYBACK POSITION

Typical LRC Facility Layouts (Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.)


AUDIOVISUAL STORAGE
INSTRUCTOR
WINDOW
2
WINDOW
WINDOW
2
LEARNING RESOURCE CENTER
CHALKBOARD
CLASSROOM/STUDY AREA STUDENT DESKS
STUDY CARRELS
WINDOW
WINDOW
TO LAB
3
SCREEN
REFERENCE MATERIALS AND PERIODICALS

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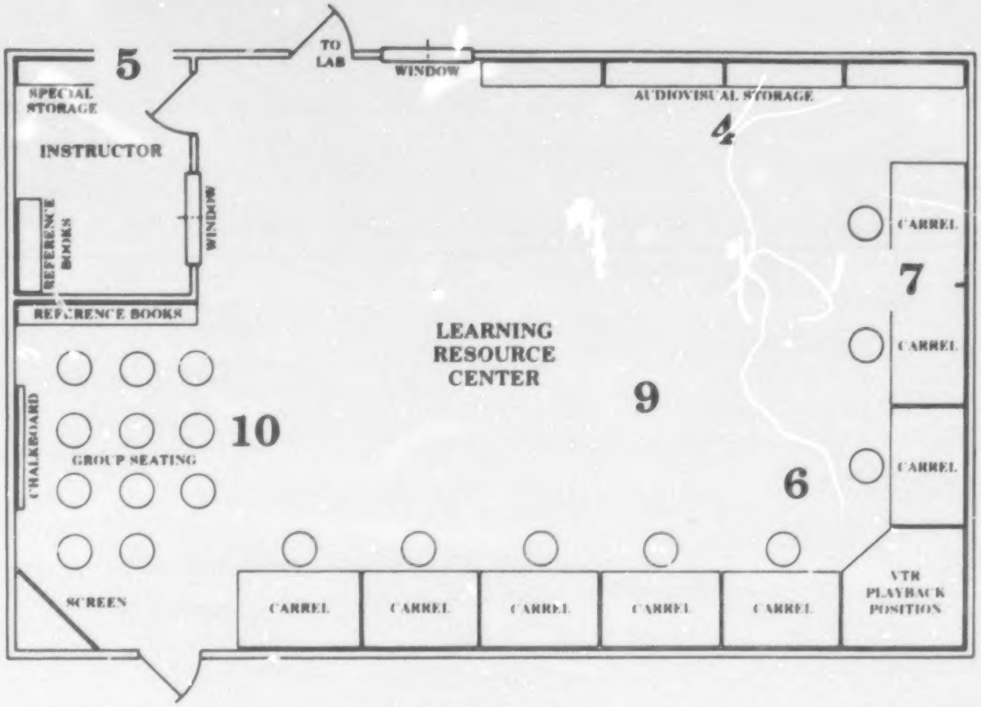
CHECKLIST	COMMENTARY
(continued) 4. Is there an adequate system for storage of visuals (such as slides) and audiovisuals? (NOTE: Can the handicapped and special needs students access them?)	and tape for each unit together in a package, or in adjacent shelves if possible. Label both the slide tray, its box and the associated tape clearly. This provides for ease of use and easier at-a-glance inventory control.
5. Has provision been made for the safe storage of master copies of slides, tapes, etc.?	The implication here is that you will not allow master copies of media to be used directly by the students, but will safely store the masters for use when needed. Where possible, only the copies from masters will be found on the student retrieval shelves for use by the students.
6. Has AV viewing equipment been set up for ease of use?	Audiovisual viewing equipment may be stationary in the LRC or may be distributed about the shop (at benches or work stations). You may also have one or more audiovisual machines set up on portable carts for mobility.
7. Does the AV viewing station have sufficient room for student study?	Each audiovisual position, whether it be a carrel, a desk, or whatever, should have adequate room for students to spread out their books, notebooks, etc.
8. Do you have spare AV equipment and parts?	It is a good idea to have at least one back-up machine.
9. Do you have a reasonable number of AV viewing positions?	The ratio of students to audiovisual stations varies from program to program. Probably


5
TO LAB
WINDOW
SPECIAL STORAGE
AUDIOVISUAL STORAGE
4
INSTRUCTOR
WINDOW
REFERENCE BOOKS
CARREL
7
REFERENCE BOOKS
LEARNING RESOURCE CENTER
CARREL
9
CHALKBOARD
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6
SCREEN
CARREL
CARREL
CARREL
CARREL
CARREL
VTR PLAYBACK POSITION

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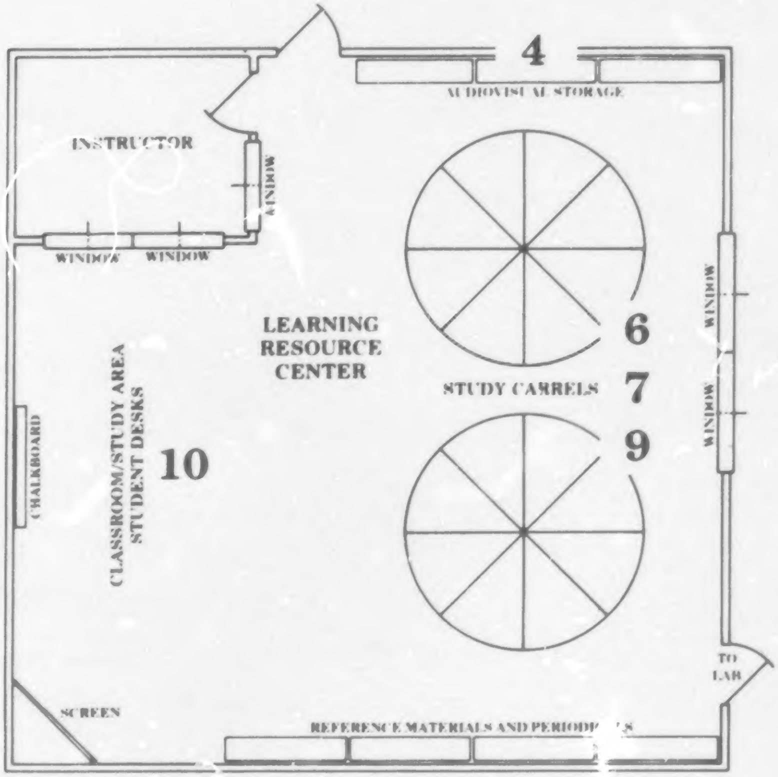
4
AUDIOVISUAL STORAGE
INSTRUCTOR
WINDOW
WINDOW
WINDOW
LEARNING RESOURCE CENTER
6
STUDY CARRELS
7
9
WINDOW
WINDOW
CHALKBOARD
CLASSROOM/STUDY AREA STUDENT DESKS
10
TO LAB
SCREEN
REFERENCE MATERIALS AND PERIODICALS

838

CHECKLIST	COMMENTARY
(continued) 9. Do you have a reasonable number of AV viewing positions?	the maximum number of audiovisual machines required would be one machine for every five students. In many programs, one station for every ten students will be sufficient. At any rate, most schools have found it beneficial to standardize on the type of audiovisual machine used. The rear-projection combination sound-slide machines are quite popular for this application.
10. Do you have an area for small group sessions, demonstrations, and the like?	This area may include movable chairs or desks which are easily relocated. Also, it is a good idea to have a screen, an overhead projector and a chalkboard available to the instructor.
11. Is there a place for private conferences with students?	As indicated earlier, this place would normally be the instructor's office. The office may or may not be integrated into the building space occupied by the LRC. One advantage of having the office in this area is that the LRC area is generally quieter than the shop or lab areas."[2]

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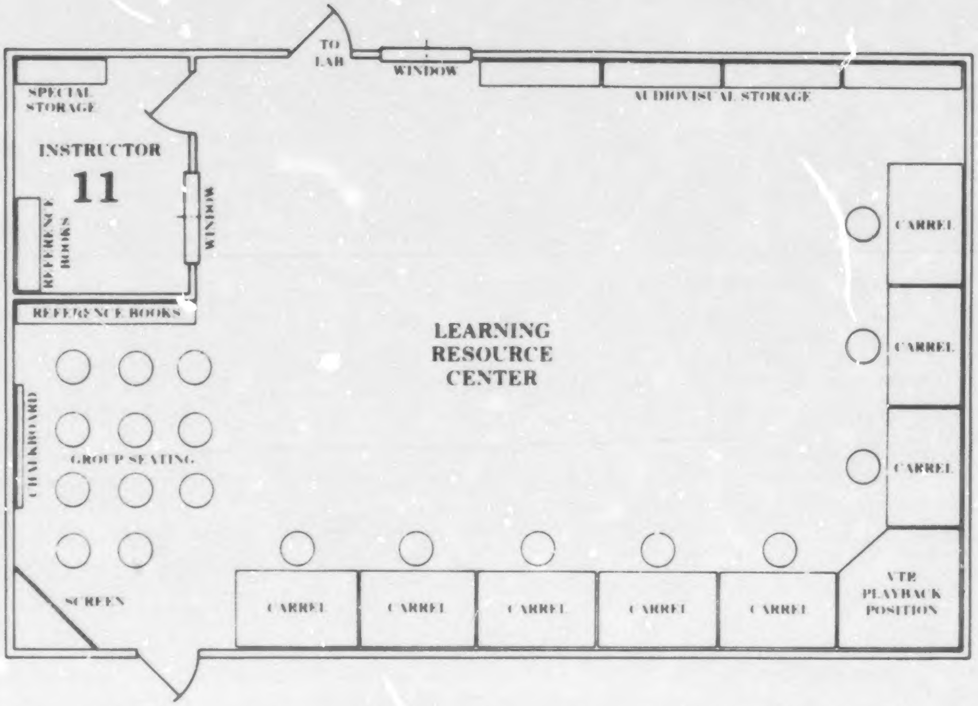
[2] Meade, Russell L. Installing and Operating an Individualized Instruction Program. Atlanta, GA: Georgia Department of Education, 1982.


SPECIAL STORAGE
TO LAB
WINDOW
AUDIOVISUAL STORAGE
INSTRUCTOR
11
REFERENCE BOOKS
WINDOW
REFERENCE BOOKS
LEARNING RESOURCE CENTER
CARREL
CARREL
CARREL
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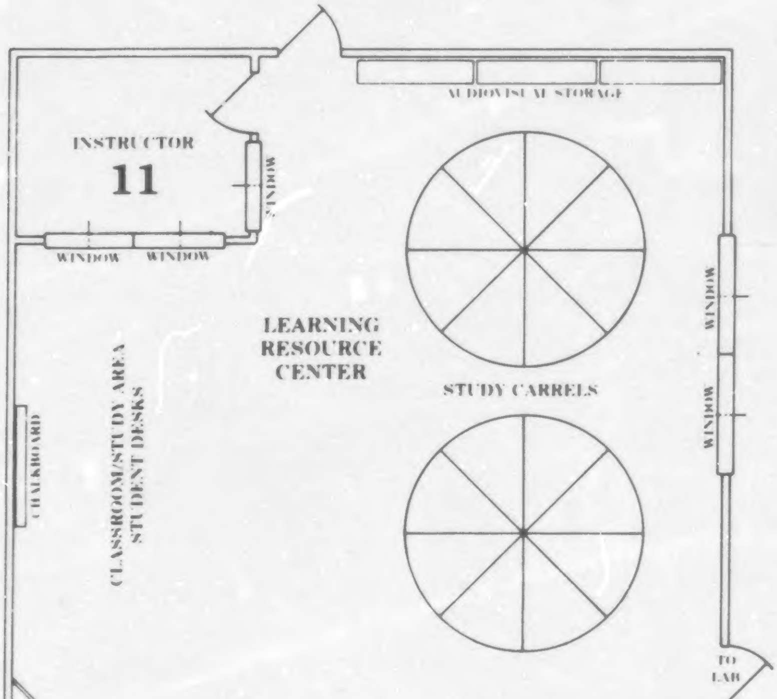
SCREEN
CARREL
CARREL
CARREL
CARREL
CARREL
VTR PLAYBACK POSITION

Typical LRC Facility Layouts (Note: Special needs students with handicapping conditions should be considered in aisle widths, heights of equipment and storage, etc.)


AUDIOVISUAL STORAGE
INSTRUCTOR
11
WINDOW
WINDOW
WINDOW
LEARNING RESOURCE CENTER
STUDY CARRELS
WINDOW
WINDOW
CHALKBOARD
CLASSROOM/STUDY AREA STUDENT DESKS
TO LAB
SCREEN
REFERENCE MATERIALS AND PERIODICALS

SPECIAL NEEDS

SPECIAL NEEDS

Contents Listing

Special Needs Introduction 3
Working With Special Needs 4

SPECIAL NEEDS INTRODUCTION

This section provides a general overview of special needs students. Included in this section are directions for developing and implementing an Individualized Education Plan (IEP), and also included is information on modifying facilities and equipment for special needs students.

This section also provides two actual case situations, one of which is a student who is physically handicapped and the other is a student who is educable mentally retarded.

WORKING WITH SPECIAL NEEDS STUDENTS

INTRODUCTION

In recent years, the mainstreaming of special needs students into regular vocational program environments has been an area of great concern to vocational educators. The result of this concern has produced an abundance of newly developed resource materials and a variety of skillfully trained personnel specialized in working with special needs students.

To present a complete set of procedures for solving all types of special needs problems in this one entity would be impossible. However, if vocational administrators, vocational instructors, counselors and related personnel will judiciously utilize the resources presented in this section, much of the indepth information required for mainstreaming those very special and unique students can be assembled.

TOPICS COVERED IN THIS SECTION

1. Who are special needs students and how are they identified?
2. What is the Individualized Educational Plan (IEP)?
3. How is the IEP developed and who is responsible for its development?
4. How is the IEP implemented?
5. How can more information regarding special needs students be attained?

WHO ARE SPECIAL NEEDS STUDENTS AND HOW ARE THEY IDENTIFIED?

Special needs students are those students who are designated as handicapped or disadvantaged. The 1976 vocational amendments define handicapped individuals as:

> "Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs."

In those same amendments, disadvantaged persons are defined as:

> "Persons (other than handicapped persons) who have academic or economic

disadvantages and who require special services, assistance or programs in order to succeed in vocational education programs."

Federal legislation requires that special needs students be given an opportunity to function in regular vocational programs.

Figure 1 presents a conceptual model depicting various activities of the process in identifying special needs students so they can be mainstreamed into vocational education programs. These activities are conducted at the following three levels:

1. Community -- vocational rehabilitation, psychologists, speech pathologists, etc.
2. School -- special education personnel, counselors, administrators, etc.
3. Classroom -- vocational instructors, peers, parents, etc.

THE CONCEPT OF MAINSTREAMING

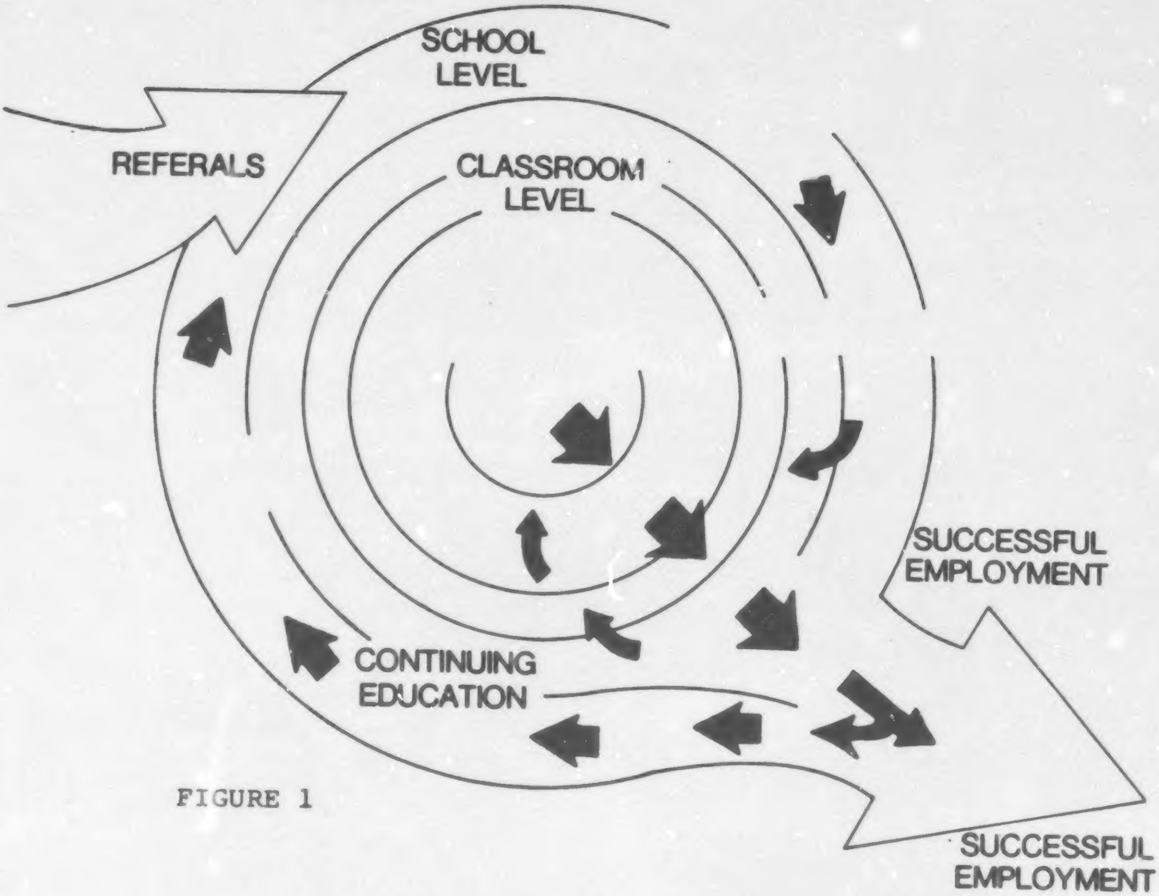

SCHOOL LEVEL
REFERALS
CLASSROOM LEVEL
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
SUCCESSFUL EMPLOYMENT

FIGURE 1

At the community level, the identification of special needs students is accomplished through a collection of data in the following areas:

- --Medical history
- --Educational records
- --Vocational development
- --Communication skills
- --Dexterity/motor skills
- --Adaptive behavior
- --Teacher observations

If any positive indications of particular problems/ handicapping conditions are disclosed from this data, a student is referred to appropriate personnel who are trained in the area of special education. Both community and school level personnel work directly with vocational instructors to achieve the common goal of mainstreaming special needs students into regular program environments.

WHAT IS THE INDIVIDUAL EDUCATIONAL PLAN (IEP)?

As part of the referral and school intake process, an Individualized Educational Plan (IEP) should be initiated. The IEP is a plan for the education of an individual. Specifically, the plan describes what a student is expected to do upon course completion and how the learning experiences will be performed to assure those outcomes.

Presently the IEP is mandated only for handicapped students. The base content for the IEP is outlined in Public Law 94-142. According to that outline, the IEP must include the following information:

1. Student's present level of functioning;
2. Student's long range instructional objectives;
3. Student's short range instructional objectives; and
4. Criteria to determine that specified objectives have been achieved.

HOW IS THE IEP DEVELOPED AND WHO IS RESPONSIBLE FOR ITS DEVELOPMENT?

Vocational instructors have had minimal or no preparation in working with special needs students. Therefore, the IEP, a plan to aid special needs students in achieving their occupational needs, should be devised. The following steps function as a guide in in the development of an IEP.

STEP 1: Review Status of Student

A. You are notified that a special student can profit from being enrolled in your vocational program.

B. After notification, contact your student personnel services coordinator and ask for a detailed report of the student's assessed status.

C. Review the report until you thoroughly understand the student's assesment.

STEP 2: Personnel Involved in Staffing

A. You must become involved in the staffing sessions that relate to vocational education. Only you, the vocational instructor, can relate a student's interests, strengths and limitations to your particular program.

B. Others included in the staffing sessions are special education personnel, the student when necessary and support personnel such as psychologists, speech pathologists, etc. on an as-needed basis.

STEP 3: How the IEP is Determined?

A. Based on the interaction of all persons involved in the staffing sessions, annual goals, short term objectives, evaluation procedures, instructional procedures and special required services are determined. (See Figures 2 and 3.)

B. Placement of the special needs student into a regular program environment is made.

C. The IEP is signed by all staffing participants.

D. The IEP is made available to all personnel involved with the education of the special needs student.

The IEP permits a special needs student to progress through a vocational program at his or her optimum rate. The progress should be frequently assessed to determine where the student is relative to the IEP objectives. If problems are detected, a staffing should be conducted to re-evaluate the IEP and to establish which educational approach is most beneficial to the student.

NOTE: Evaluation of the special needs student's program is critical. Through assessment, current students may be assisted and information that will improve the potential to help future students with similar difficulties may be gathered. An effective evaluation system should consist of:

---en-route evaluation (formative) to monitor the student's progress through the program;
---summative evaluation upon completion of the program to determine job readiness;
---follow-up after job placement to determine if the student is successful on the job; and
---follow-through activities designed to identify any further training needed (indicated by the follow-up procedure).

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Long Term
Individualized Education Plan (IEP)

Student: ______________________________ **Date:** ______________

School: ______________________________ **DOB:** ________ **Age:** ___

Present Levels of Educational Performance:

Academic

WRAT: Date ________, Reading ______, Spelling ______, Arithmetic ______

PIAT: Date ________, Math ______, Reading Recognition ______, Reading Comprehension ______
Spelling ______, General Information ______, Total Test ______.

MAT: Date ________, Total Reading ______, Total Arithmetic ______

Gaites: Date ______, ______________________________

Other: ______________ Date _______, ______________________________

Other: ______________ Date _______, ______________________________

Social Adaptation

Alpern Bell: Date _______, ______________________________

Walker: Date _______, ______________________________

Vineland: Date _______, ______________________________

Other: ______________ Date _______, ______________________________

Pre-Vocational Skills

Psychomotor or Physical Education Skills

Self-Help Skills

Annual Goals:

Specific Education Services
Program and Amount of Time in Special and Regular Education

	Self-Contained	Resource	Itinerant	Reg. Ed.	Voc. Ed.	Initiation Date	Duration Date
EMR							
SLD							
BD							
Speech							
Gifted							
H/H (Other Health Impaired)							
M/H							
SMR							
TMR							
Visually Imp.							
Hearing Imp.							
Other Physical therapy							
R.V.I.							

FIGURE 2

Transportation ____________________
Physical Therapy ____________________
Occupational Therapy ____________________
Vocational Rehabilitation ____________________
Rutland Center ____________________
GRC ____________________
Other ____________________

Type P.E. Program: Mainstream ____________________ Other ____________________

Long-Term educational goals appropriate for specific needs of student:
(The checked items are the goals appropriate for ____________________ specific educational needs.)

- ___ To improve math calculation skills.
- ___ To improve math reasoning skills.
- ___ To improve oral expression.
- ___ To improve basic reading skills.
- ___ To improve reading comprehension skills.
- ___ To improve written expression skills.
- ___ To improve listening comprehension skills.
- ___ To improve visual-motor skills.
- ___ To improve language/communication skills.
- ___ To improve classroom behavior.
- ___ To improve ability to follow directions.
- ___ To improve self-confidence.
- ___ To improve reality orientation.
- ___ To improve functional math skills.
- ___ To improve functional reading skills.
- ___ To improve achievement in mainstream.
- ___ To reduce frequency of acting out and/or agressive behavior.
- ___ To improve social interaction skill (adult and/or peer relationships).
- ___ To increase participation in classroom and school activities.
- ___ To improve physical mobility.
- ___ To develop self-help skills.
- ___ To improve pre-vocational skills.
- ___ To improve vocational skills and provide work stations.
- ___ To provide on-the-job training.
- ___ To improve home/school communication.
- ___ To improve gross-motor skills.
- ___ To improve fine-motor skills.

Other: ____________________

Review Date: __________ (Place date and yes or no if goals are achieved according to short term objectives or review date.)

The IEP is an educational and related services plan and not a binding contract for which the school is responsible if the child does not achieve the growth projected in the goals and objectives. However, the school system will provide those services listed on the IEP.

I understand that short term instructional objectives which must be measurable intermediate steps between the present level of educational performance and the annual goals will be developed within 30 days of the projected date for initiation with permission of parents.

I have seen and understand the IEP for my child. I have been informed and understand my right to initiate a formal due process hearing if I disagree with my child's IEP. I have been informed of all the procedures applicable to such a hearing.

____________________ (Date)
____________________ (Parent's Signature)

Documentation of attempts to involve parents in IEP development.

Present: Principal ____________________
Sp. Ed. Coord. ____________________
Teacher ____________________
Parent ____________________
Counselor ____________________
School Psy. ____________________
Sp. Ed. Teacher ____________________
Other ____________________

Date: Letter sent ____________________
Home Visit ____________________
Phone Call ____________________
Other ____________________

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Documentation of Attempts to Involve Parent/Guardian in Development of Short Term Instructional Objectives

Date	Comment
______	________________
______	________________
______	________________
______	________________

COUNTY SCHOOL SYSTEM

SHORT TERM INSTRUCTIONAL OBJECTIVES

____
PROGRAM

Note: Complete staffing and documentation information if developed separately from Total Service Plan. Short term objectives __must__ be developed prior to placement.

Date of Short Term Instructional Objectives Staffing: ____________________

Committee Members Present at Short Term Instructional Objectives Staffing:

	Name	Title
1.	______________	________________
2.	______________	________________
3.	______________	________________
4.	______________	________________

Student: ________________________________ Person to Provide Service: ________________________________

Short Term Instructional Objectives	Criteria for Mastery	Date Reviewed	Method of Evaluation	Mastery	
				Yes	No

Figure 2

IMPLEMENTING THE IEP

After the IEP has been developed, the implementation process begins by integrating the special needs student into a regular vocational program. In most cases, a vocational program as it exists will not accommodate special needs students. Therefore, adjustments will be necessary.

In discussing adjustments, a review of some general learning needs of special needs students might prove helpful in determining program modifications.

THE ORTHOPEDICALLY HANDICAPPED usually require attention to facilities and equipment. Beyond that, their learning needs are as varied as those of the normal population. Remember, some of these individuals will actually be highly gifted in their chosen fields. Their major needs will be psychological and coping with the school environment.

THE LEARNING DISABLED possess average or above average intelligence, however, they have specific learning problems. In modifying the curriculum, much more emphasis should be placed on auditory and visual modes of instruction. Also, practical application of tasks is an excellent learning tool. In many incidents, repetition of instruction may be warranted.

THE HEARING AND VISUALLY IMPAIRED can be accommodated by common sense and the use of supporting resource personnel. Larger print, braille and recordings can be used in teaching the blind. Captions on visual materials, seating arrangements, use of notes from a classmate, lower reading level textbooks, oral testing and total communications can be used for instructing the deaf.

THE EDUCABLE MENTALLY RETARDED will constitute a major population now entering vocational education. The key concept in modifying the curriculum for this population is that they require much more detail in order to learn and that they require a great deal more practice time. All curriculum modifications for these groups should be made by detailing each task or objective into its smallest parts and by providing for more and more practice.

A review of the learning needs indicates that regular vocational programs must be modified for special needs students.

In making alterations, vocational instructors should never change the content of a program for special needs students. REMEMBER! ALL VOCATIONAL EDUCATION PROGRAMS ARE BASED ON REAL JOBS THAT HAVE THEIR OWN TASKS AND STANDARDS. AS FAR AS YOU ARE CONCERNED, YOU HAVE NO POWER TO CHANGE THESE. YOU ALSO CANNOT SUCCESSFULLY CREATE AN ENTIRELY NEW JOB.

Although instructional content cannot be changed, instructional facilities and strategies can be modified to help special needs students function in a regular vocational program.

Modifying The Instructional Facilities and Equipment*

Modification of facilities and equipment is a concern when working with the physically handicapped. Laws require that all school buildings must meet specifications pertaining to the accessibility of all handicapped persons. As a vocational instructor, your main concern is to insure that your classroom and laboratory allows handicapped students to be comfortable and above all to learn. The following listing presents specific ways to facilitate both comfort and learning for handicapped students.

A. FACILITIES

1. All unnecessary obstructions should be removed from the classroom.
2. There should be ample space between aisles and around equipment.
3. Storage areas for students in wheelchairs should be provided.
4. Floors should have a nonskid surface to handle wheelchairs and crutches adequately.
5. Work benches, storage cabinets, etc., should be altered in height to accommodate wheelchairs.
6. Handles should replace knobs on cabinets and doors.
7. Mobile demonstration tables can be used for mobility impaired students.
8. Sinks and water controls should be accessible. For example, batwing faucets and gooseneck spigots are more usable by orthopedically handicapped students.

B. EQUIPMENT

1. Guard plates (where feasible) should be utilized on power equipment.
2. Power switches can be moved for easier accessibility.
3. Semi-stationery equipment can be put on a variable height base.
4. Hand controls may be added to machines usually operated by foot controls.
5. Special lightweight hand tools with extra large handles can be used for students with limited hand strength.
6. Lighted switches can be installed to show when machines are in operation for the hearing impaired.
7. Lights can also be installed along with auditory alarm devices.

*Listings and diagrams are provided through the courtesy of the Georgia Department of Education and Douglas Gill, Working With Special Needs Students: A Handbook for Vocational Education Teachers.

8. For the visually impaired, control dials with tactile markings can be used.
9. Auditory alarms together with visual alarms can be installed for persons with sight problems.
10. Specifically designed devices can also be obtained for visually impaired students such as:
    a. Braille shorthand machines;
    b. Braille micrometers and rulers;
    c. Auditory calculators;
    d. Automatic fluid measuring devices for darkroom work; and
    e. Feed indicator for lathes.

GENERAL ACCESSIBILITY STANDARDS

Dimensions of typical adult-size wheelchair (inches)

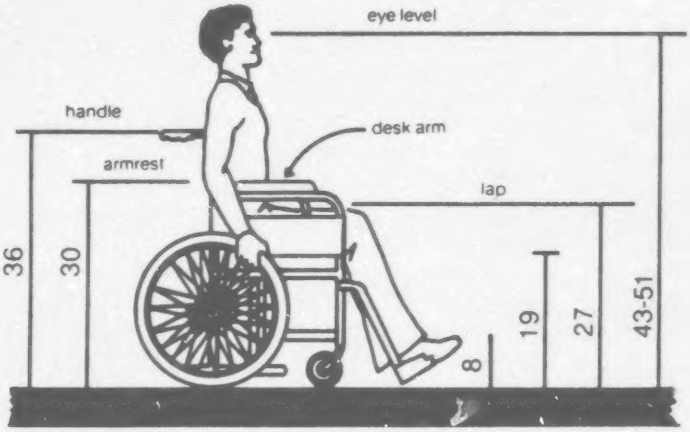


FIGURE 4

Average reach limits from wheelchair

FIGURE 5

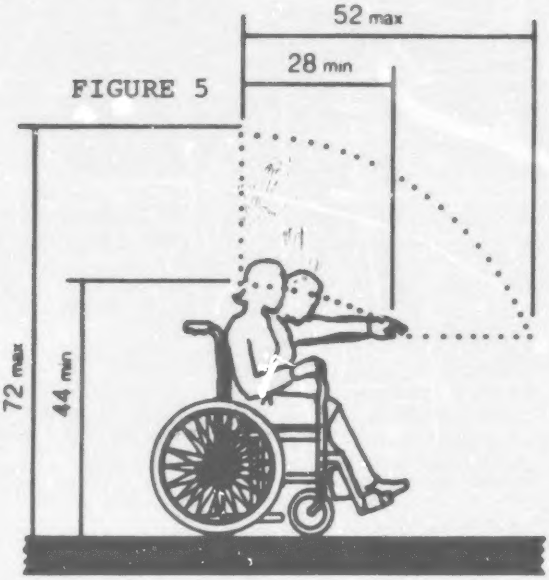

52 max
28 min
72 max
44 min

FIGURE 6

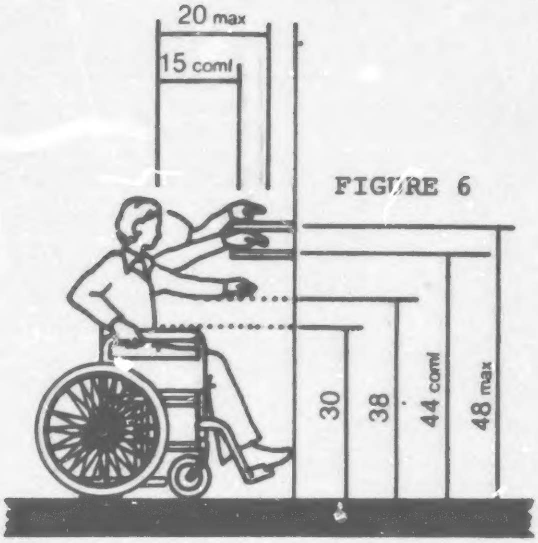
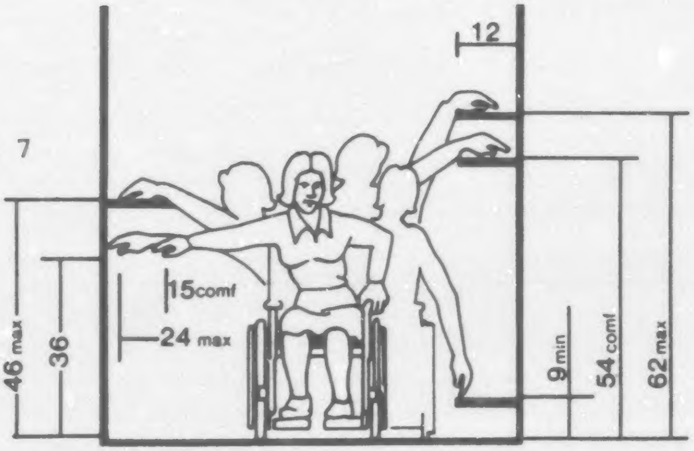

20 max
15 comf
30
38
44 comf
48 max

FIGURE 7


12
15comf
24 max
46 max
36
9min
54comf
62max

Maneuvering space and wheelchairs

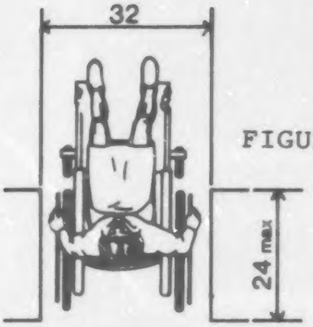


FIGURE 8

Minimum Clear Opening

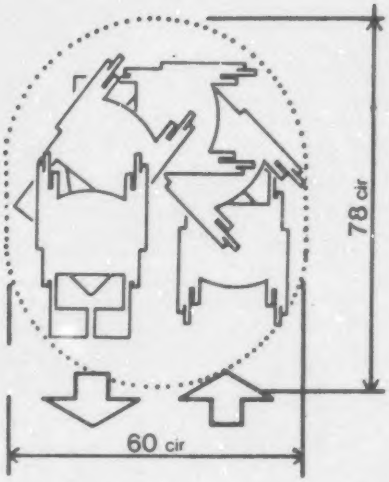

78 cir
60 cir

FIGURE 9

U-Turn

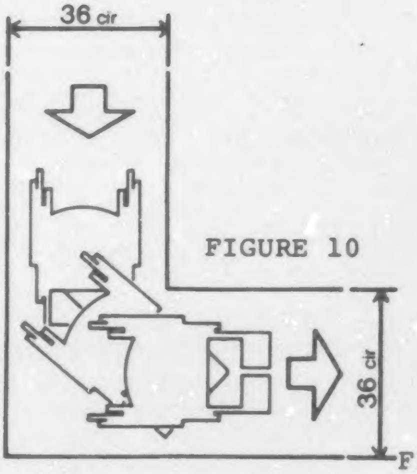
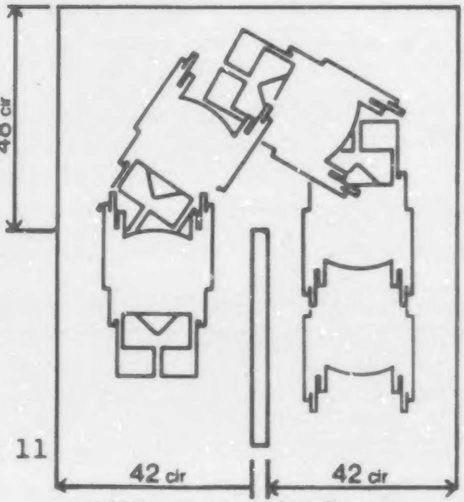

36 cir
36 cir

FIGURE 10

L-Turn

FIGURE 11


48 cir
42 cir
42 cir

180° turn around wall

Clearance widths in passing

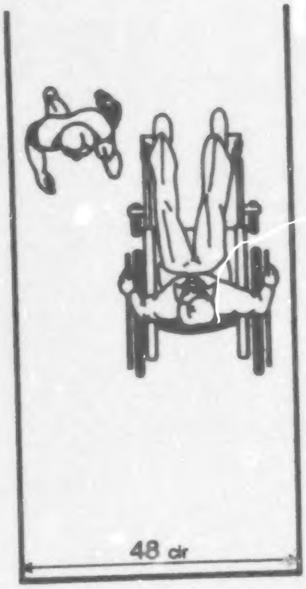


FIGURE 12

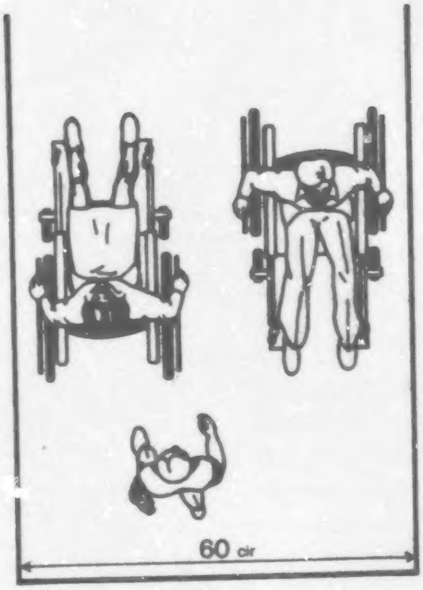


FIGURE 13

Use of cane

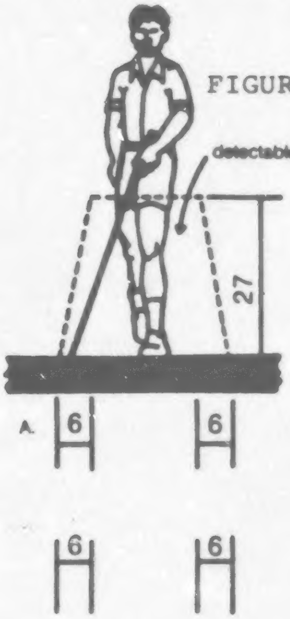

detectable area
27
A.
6
6
6
6

FIGURE 14

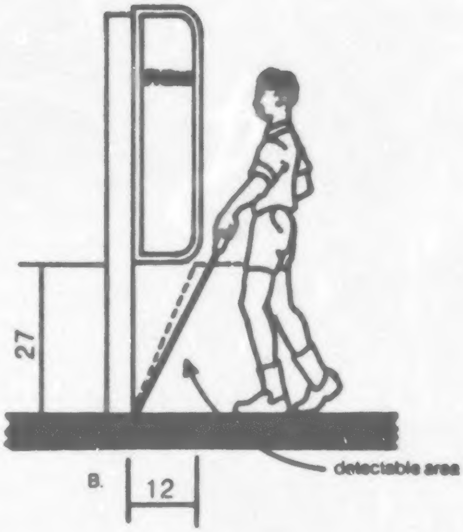

27
detectable area
B.
12

FIGURE 15

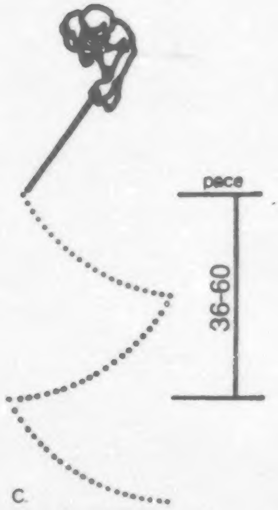


FIGURE 16

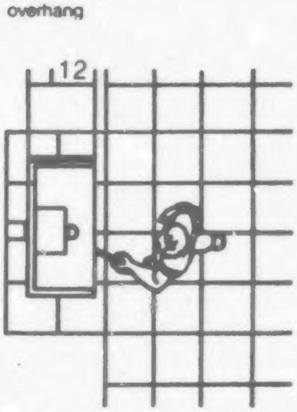

overhang
12

FIGURE 17

Accessibility standards and measurements are from the American National Standard Institute's Specifications for making buildings and facilities accessible to and usable by physically handicapped people.

Modifying Instructional Strategies

Based on the long term goals and short term objectives specified by the IEP, you, the vocational instructor, are to develop teaching strategies to insure that the objectives are met. Instructional strategies should reflect the best learning techniques for an individual special needs student.

Listed below are various examples of the instructional methods which may be used in modifying existing teaching strategies to accommodate special needs students. Only a few suggestions are provided; an abundance of techniques exist.

Instructor Demonstration: Simply show the student how the job is to be done in clear distinct steps.

Peer Demonstration: This technique allows the instructor to use one of the advanced students to demonstrate a particular task in a step by step fashion. It is a flexible system. For example, you can use peer demonstration to show each task step while you explain them to the students. When working with the mentally retarded, you will never have enough time to demonstrate a task as often as they may need to see it. In such situations, the well prepared advanced student can perform and explain the same demonstration several times.

Shadowing: Shadowing can be used in conjunction with demonstrations. By shadowing, the student is allowed to do exactly what the demonstrator does. This allows the student to learn in a see and do fashion. The student may shadow the instructor, an advanced peer or in some instances the worker on the job.

Job Site Visits: Job site visits offer the student an opportunity to see the work being done in its natural location. Students can develop a worker identity and a realistic view of how the tools, equipment and materials are brought together to produce the product.

Work Group or Team: By being a part of a work team, the student can learn the various roles in an occupation as having the opportunity to practice specific sets of skills under the tutelage of peers.

Individualized Instruction: Appropriately prepared or adjusted individualized instruction is a big help in managing a class that contains a mixture of special needs population students and "norm group" students. Individualized instruction, no matter what the source, will require much developmental input from the instructor. In most all cases, however, the results are worth the effort.

Media: Many of the special needs populations require mediated instruction (i.e., hearing and visually impaired), however, the use of appropriate media enhances learning for all students. Media can range from a line drawing in an instructional module, to a video tape, to posters and charts. It can be instructor made or commercial. All that matters is that it exactly links to the objective.

Project Method: The value in using projects with special needs population students is that they help them mentally and physically unify all the parts into a uniform whole. Because of the detail required for them to learn, they need learning activities that relate all of the parts of the whole. The development of a product through an assigned project is an ideal integrating experience.

Simulations: Simulations meet a variety of instructional needs. One of the more important simulations with special needs population students is providing the opportunity to develop proper safety concepts before actually working with the "live" equipment that could be dangerous to a careless student.

Role Playing: Role playing is a part of several other instructional strategies. On its own, it is a very good procedure for developing the attitudes and values required of a successful worker -- i.e. a sense of responsibility, the ability to take orders and follow directions, interpersonal skills and so on. It is a way to concentrate on developing good work habits and positive attitudes.

Peer Instruction: Like peer demonstrations, peer instruction is able to multiply the instructor's available time. This allows individual students with specific needs to have more assistance. Peer instruction has values beyond expanding time; it is an excellent approach to learning. In almost every situation, both the peer teacher and the peer student profit from the exchange. In operation peer instruction is simply a matter of preparing and allowing one of the advanced students to teach small groups certain segments of a course.

Team Teaching: As we have already noted, some special needs populations require a combination of vocational and special education presented in harmony. A team approach is the only way to meet that need. For team teaching to be effective, clarification of student needs, as defined by the IEP, and careful planning will be required.

Peer Apprenticeships: The peer apprenticeship is an ideal way to induct the new special needs population student into the curriculum. By serving as the apprentice to an advanced student, the special needs population student can become climatized to the laboratory/shop and can begin to learn the tools, equipment and materials of the program. The shadow technique can also be added to increase hands-on learning.

Assessment and Feedback: Student learning can be improved by frequently assessing students' skills and feeding back their strengths and weaknesses. Through a process of positive feedback, the student can be moved gradually from where he or she is to the skill level required.

The ultimate goal of all this effort is not employment--rather successful employment. Successful employment implies that not only is the special needs student placed in a job, but that the student is able to sustain himself or herself in a working environment over an extended period of time. In some instances, students do completely exit the educational system. However, many students, in addition to obtaining a job, periodically continue in the educational system to refine existing skills or to broaden their capacities.

CASE SITUATIONS

Upon becoming aware that special needs students will be mainstreamed into their programs, instructors often respond with, "Those students will never be able to pass my class." In many cases, this assumption is true. Special needs students may have handicapping conditions which prohibit them from accomplishing every task or unit competency in this curriculum guide. Do not expect them to perform at the level of regular students; chances are they can not and will not. You, the instructor, have to realize that special needs students have real limitations and that your responsibility is to teach them as many tasks as possible for securing some type of skill to become functional in the workforce. A person who can pump gas is employable. A person who can count money is employable. A person who can thread a sewing machine is employable. Even though these tasks are seemingly uncomplicated to us, they can mean a great deal to a special needs student.

The following two situations present how one vocational teacher incorporated two types of special needs students, the physically handicapped and the educable mentally retarded, into his program. After becoming aware of both students' capabilities, the instructor began to adapt tasks/unit competencies from the curriculum guide for instruction. The instructor relied on the special educational personnel and other support staff in working with his special needs students.

SITUATION 1: JOE JONES

Joe is a special needs student. Please review his long term IEP to learn more about him.

Long Term
Individualized Education Plan (IEP)

Student: Joe Jones **Date:** 8-30-85
School: Central High School **DOB:** 3-4-69 **Age:** 16

Present Levels of Educational Performance:

Academic

WRAT: Date 4-25-84, Reading 2.1, Spelling 2.3, Arithmetic 2.8
PIAT: Date 4-25-84, Math 3.3, Reading Recognition 2.2, Reading Comprehension 2.8
Spelling 2.5, General Information 3.8, Total Test 2.8.
MAT: Date ________, Total Reading _____, Total Arithmetic _____
Gaites: Date _______, ____________________
Other: Binet Date 10-11-84, ____________________
Other: ____________ Date _______, ____________________

Social Adaptation

Alpern Bell: Date _______, ____________________
Walker: Date 4-25-84, shows no acting out behavior
Vineland: Date 4-25-84, 15-4
Other: ____________ Date _______, ____________________

Pre-Vocational Skills

Joe likes to work on appliances, work outside and paint. He has a CETA job as helper for maintenance at school. Vocational Rehab. evaluates either maintenance or the field of electromechanical as a career.

Psychomotor or Physical Education Skills

P.E. teacher indicated that P.E. skills are above average. He has played on the basketball team.

Self-Help Skills

Annual Goals: Upon completion of the course, the student will be able to follow oral and/or written directions, identify various types of electrical apparatus, select proper tools for specific jobs, and prepare appliances for installation.

Specific Education Services
Program and Amount of Time in Special and Regular Education

	Self-Contained	Resource	Itinerant	Reg. Ed.	Voc. Ed.	Initiation Date	Duration Date
EMR		2 hr/day			2 hr/day	8-30-85	1 year
SLD							
BD							
Speech							
Gifted							
H/H (Other Health Impaired)							
M/H							
SMR							
TMR							
Visually Imp.							
Hearing Imp.							
Other Physical therapy							
R.V.I.		1 hr/day				8-30-85	1 year

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Transportation NA
Physical Therapy NA
Occupational Therapy NA
Vocational Rehabilitation once a week for counseling
Rutland Center
GBC
Other

Type P.E. Program: Mainstream 1 hr/day Other

Long-Term educational goals appropriate for specific needs of student:
(The checked items are the goals appropriate for Joe Jones specific educational needs.)

X To improve math calculation skills.
X To improve math reasoning skills.
___ To improve oral expression.
X To improve basic reading skills.
X To improve reading comprehension skills.
X To improve written expression skills.
___ To improve listening comprehension skills.
___ To improve visual-motor skills.
___ To improve language/communication skills.
___ To improve classroom behavior.
X To improve ability to follow directions.
___ To improve self-confidence.
___ To improve reality orientation.
X To improve functional math skills.
X To improve functional reading skills.
___ To improve achievement in mainstream.
___ To reduce frequency of acting out and/or agressive behavior.
___ To improve social interaction skill (adult and/or peer relationships).
___ To increase participation in classroom and school activities.
___ To improve physical mobility.
___ To develop self-help skills.
X To improve pre-vocational skills.
X To improve vocational skills and provide work stations.
X To provide on-the-job training.
___ To improve home/school communication.
___ To improve gross-motor skills.
___ To improve fine-motor skills.

Other:

Review Date: Spring 1986 (Place date and yes or no if goals are achieved according to short term objectives or review date.)

The IEP is an educational and related services plan and not a binding contract for which the school is responsible if the child does not achieve the growth projected in the goals and objectives. However, the school system will provide those services listed on the IEP.

I understand that short term instructional objectives which must be measurable intermediate steps between the present level of educational performance and the annual goals will be developed within 30 days of the projected date for initiation with permission of parents.

I have seen and understand the IEP for my child. I have been informed and understand my right to initiate a formal due process hearing if I disagree with my child's IEP. I have been informed of all the procedures applicable to such a hearing.

8/30/85 (Date)
Mrs. Tom Jones (Parent's Signature)

Documentation of attempts to involve parents in IEP development.

Present: Principal
Sp. Ed. Coord.
Teacher
Parent Mrs. Tom Jones
Counselor
School Psy.
Sp. Ed. Teacher
Other

Date: Letter sent
Home Visit
Phone Call 8-24-85
Other

863

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After reviewing Joe's long term IEP, you can see that he is educable mentally retarded. Therefore, integration into a regular program requires extensive instructional modifications.

Joe was also enrolled in an Electromechanical Technology Program. His instructor, along with special education personnel, devised Joe's short term instructional objectives -- the areas he would be concentrating on in the Electromechanical Technology program. Please review Joe's short term IEP to learn more about what his studies involved.

Documentation of Attempts to
Involve Parent/Guardian in
Development of Short Term
Instructional Objectives

Date	Comment

COUNTY SCHOOL SYSTEM

SHORT TERM INSTRUCTIONAL OBJECTIVES

Electromechanical Technology
Major Appliance
PROGRAM

Note: Complete staffing and documentation information if developed separately from Total Service Plan. Short term objectives must be developed prior to placement.

Date of Short Term Instructional Objectives Staffing: August 30, 1985

Committee Members Present at Short Term Instructional Objectives Staffing:

	Name	Title
1.		Electromechanical Teacher
2.		R.V.I. Teacher
3.		Spec. Ed. Coordinator
4.		Parent

Student: Joe Jones

Person to Provide Service:

Short Term Instructional Objectives	Criteria for Mastery	Date Reviewed	Method of Evaluation	Mastery Yes	Mastery No
1. The student will remember, organize and perform a set of oral directions.	70%		Performance test	1.	1.
2. The student will select the tools needed to perform a teacher-selected task.	80%		Teacher-made exam	2.	2.
3. The student will uncrate and prepare major electrical appliances for installation.	70%		Performance test	3.	3
4. The student will demonstrate the proper use of a hand truck.	70%			4.	4.
5. The student will follow manufacturer's pre-installation assembly instructions.	70%		Final grade in class	5.	5.
6. The student will follow proper safety precautions at all times.	100%			6.	6.

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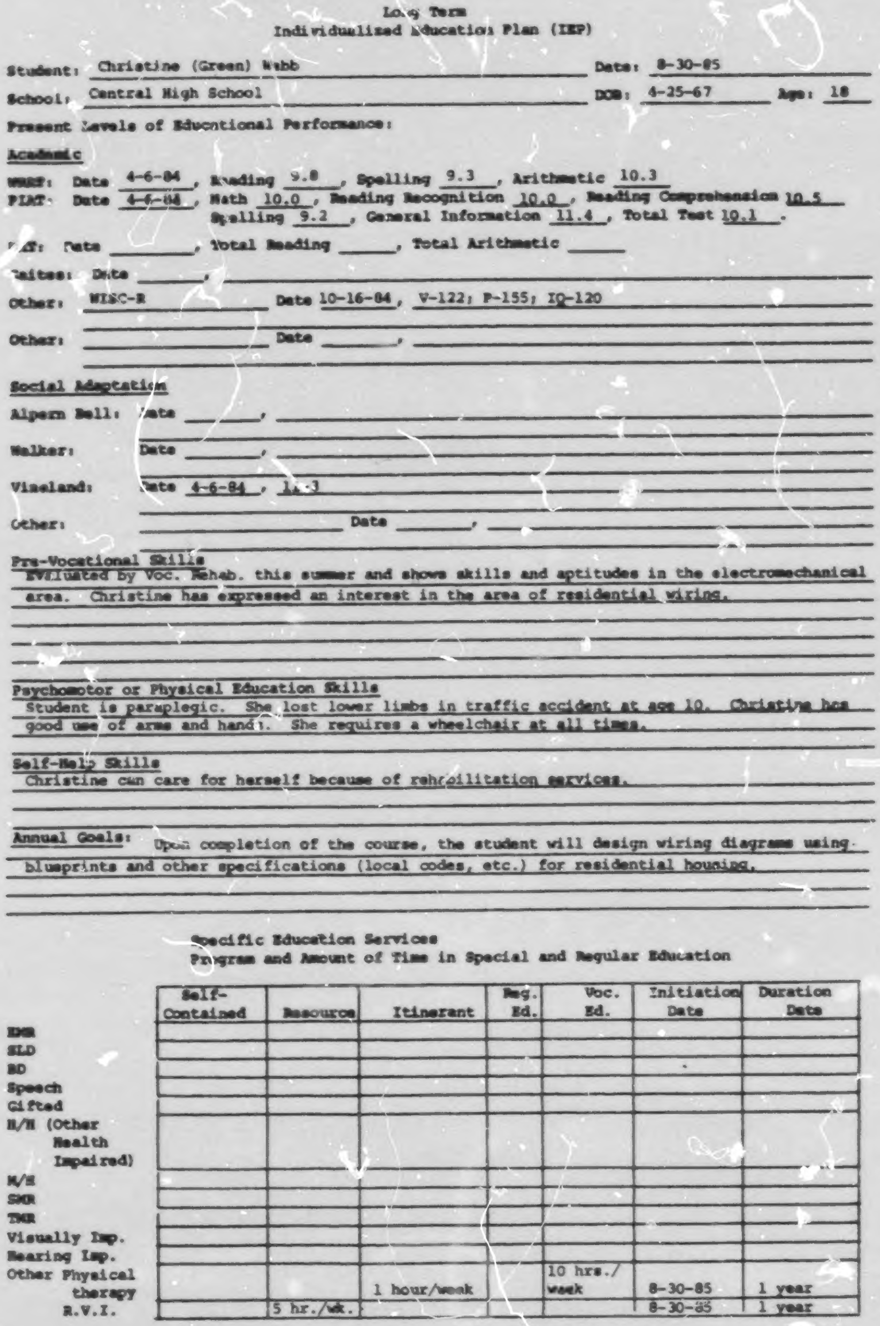
SITUATION 2: CHRISTINE GREEN WEBB

Christine is a special needs student. Please review her long term IEP to learn more about her.



Long Term
Individualized Education Plan (IEP)

Student: Christine (Green) Webb **Date:** 8-30-85
School: Central High School **DOB:** 4-25-67 **Age:** 18

Present Levels of Educational Performance:

Academic

WRAT: Date 4-6-84, Reading 9.8, Spelling 9.3, Arithmetic 10.3
PIAT: Date 4-6-84, Math 10.0, Reading Recognition 10.0, Reading Comprehension 10.5
Spelling 9.2, General Information 11.4, Total Test 10.1.
MAT: Date ____, Total Reading ____, Total Arithmetic ____
Gates: Date ____, ____
Other: WISC-R Date 10-16-84, V-122; P-155; IQ-120
Other: ____ Date ____, ____

Social Adaptation

Alpern Bell: Date ____, ____
Walker: Date ____, ____
Vineland: Date 4-6-84, 11.3
Other: ____ Date ____, ____

Pre-Vocational Skills
Evaluated by Voc. Rehab. this summer and shows skills and aptitudes in the electromechanical area. Christine has expressed an interest in the area of residential wiring.

Psychomotor or Physical Education Skills
Student is paraplegic. She lost lower limbs in traffic accident at age 10. Christine has good use of arms and hands. She requires a wheelchair at all times.

Self-Help Skills
Christine can care for herself because of rehabilitation services.

Annual Goals: Upon completion of the course, the student will design wiring diagrams using blueprints and other specifications (local codes, etc.) for residential housing.

Specific Education Services
Program and Amount of Time in Special and Regular Education

	Self-Contained	Resource	Itinerant	Reg. Ed.	Voc. Ed.	Initiation Date	Duration Date
EMR							
SLD							
BD							
Speech							
Gifted							
H/H (Other Health Impaired)							
M/H							
SMR							
TMR							
Visually Imp.							
Hearing Imp.							
Other Physical therapy			1 hour/week		10 hrs./week	8-30-85	1 year
R.V.I.		5 hr./wk.				8-30-85	1 year

Transportation special education bus
Physical Therapy once a week at Vocational Rehabilitation Center
Occupational Therapy ____
Vucational Rehabilitation once a week - counseling
Rutland Center ____
GRC ____
Other was under foster care before marriage

Type P.E. Program: Mainstream ____ Other NA

Long-Term educational goals appropriate for specific needs of student:
(The checked items are the goals appropriate for Christine (Green) Webb specific educational needs.)

____ To improve math calculation skills.
____ To improve math reasoning skills.
____ To improve oral expression.
____ To improve basic reading skills.
____ To improve reading comprehension skills.
____ To improve written expression skills.
____ To improve listening comprehension skills.
____ To improve visual-motor skills.
____ To improve language/communication skills.
____ To improve classroom behavior.
____ To improve ability to follow directions.
____ To improve self-confidence.
____ To improve reality orientation.
____ To improve functional math skills.
____ To improve functional reading skills.
X To improve achievement in mainstream.

____ To reduce frequency of acting out and/or agressive behavior.
X To improve social interaction skill (adult and/or peer relationships).
X To increase participation in classroom and school activities.
X To improve physical mobility.
X To develop self-help skills.
X To improve pre-vocational skills.
X To improve vocational skills and provide work stations.
____ To provide on-the-job training.
____ To improve home/school communication.
X To improve gross-motor skills.
X To improve fine-motor skills.

Other: ____

Review Date: Spring 1986 (Place date and yes or no if goals are achieved according to short term objectives or review date.)

The IEP is an educational and related services plan and not a binding contract for which the school is responsible if the child does not achieve the growth projected in the goals and objectives. However, the school system will provide those services listed on the IEP.

I understand that short term instructional objectives which must be measurable intermediate steps between the present level of educational performance and the annual goals will be developed within 30 days of the projected date for initiation with permission of parents.

I have seen and understand the IEP for my child. I have been informed and understand my right to initiate a formal due process hearing if I disagree with my child's IEP. I have been informed of all the procedures applicable to such a hearing.

8/30/85
(Date)

Christine Webb
(Parent's Signature)

Documentation of attempts to involve parents in IEP development.

Present: Principal ____ Counselor ____
Sp. Ed. Coord. ____ School Psy. ____
Teacher ____ Sp. Ed. Teacher ____
Parent ____ Other ____

Date: Letter sent ____ Phone Call ____
Home Visit ____ Other ____

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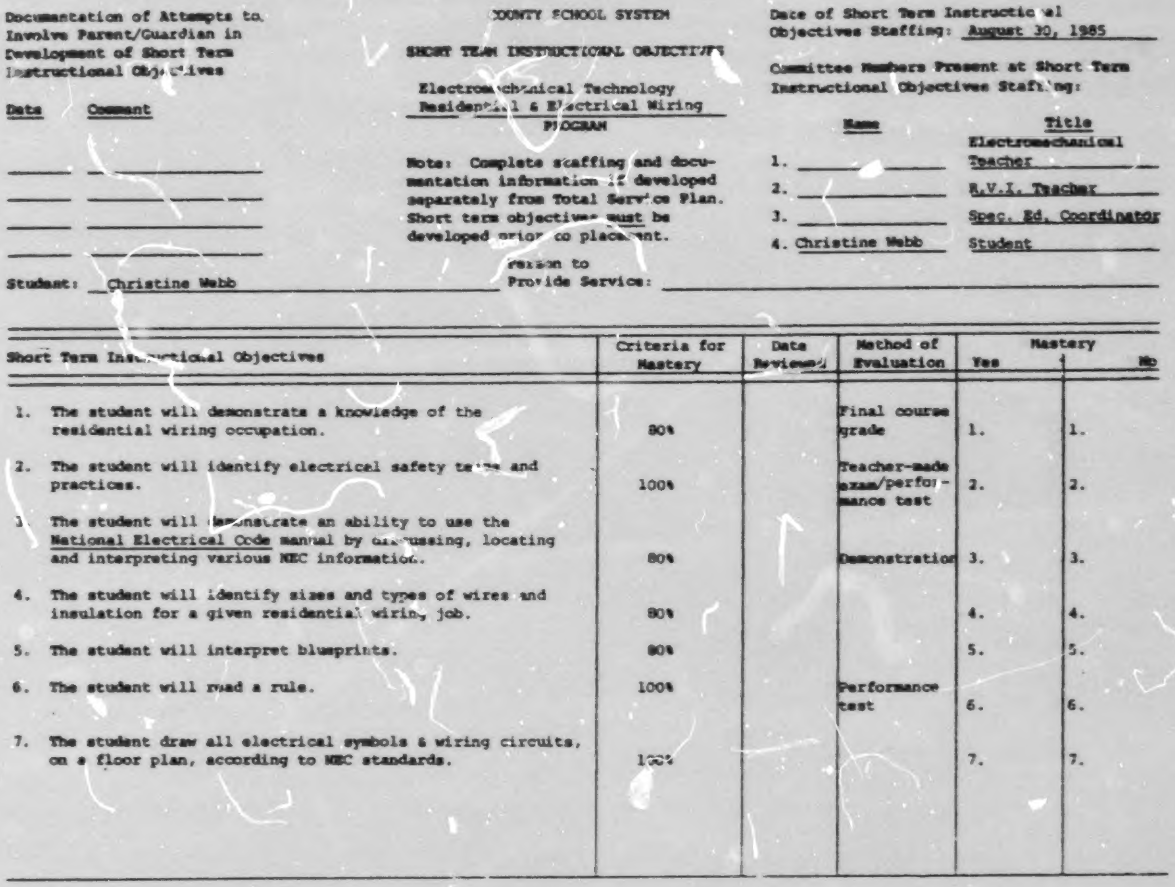
After reviewing Christine's long term IEP, you can see that she is physically handicapped. Therefore, her integration into a regular program requires facility/equipment rather than instructional modifications.

Christine was enrolled in an Electromechanical Technology program. Her instructor, along with special education personnel, devised Christine's short term instructional objectives -- the areas she would be concentrating on in the Electromechanical Technology program. Please review Christine's short term IEP to learn more about what her studies involved.



Documentation of Attempts to Involve Parent/Guardian in Development of Short Term Instructional Objectives

Date **Comment**

COUNTY SCHOOL SYSTEM

SHORT TERM INSTRUCTIONAL OBJECTIVES

Electromechanical Technology
Residential & Electrical Wiring
PROGRAM

Note: Complete staffing and documentation information if developed separately from Total Service Plan. Short term objectives must be developed prior to placement.

Date of Short Term Instructional Objectives Staffing: August 30, 1985

Committee Members Present at Short Term Instructional Objectives Staffing:

Name	Title
1.	Electromechanical Teacher
2.	R.V.I. Teacher
3.	Spec. Ed. Coordinator
4. Christine Webb	Student

Student: Christine Webb

Person to Provide Service:

Short Term Instructional Objectives	Criteria for Mastery	Date Reviewed	Method of Evaluation	Mastery	
				Yes	No
1. The student will demonstrate a knowledge of the residential wiring occupation.	80%		Final course grade	1.	1.
2. The student will identify electrical safety terms and practices.	100%		Teacher-made exam/performance test	2.	2.
3. The student will demonstrate an ability to use the National Electrical Code manual by discussing, locating and interpreting various NEC information.	80%		Demonstration	3.	3.
4. The student will identify sizes and types of wires and insulation for a given residential wiring job.	80%			4.	4.
5. The student will interpret blueprints.	80%			5.	5.
6. The student will read a rule.	100%		Performance test	6.	6.
7. The student draw all electrical symbols & wiring circuits, on a floor plan, according to NEC standards.	100%			7.	7.

RESOURCES

You, the vocational instructor, do not always have sufficient skills for dealing with the multitude of problems which may arise when working with special needs students. Included in this section are suggested resource personnel and suggested resource materials to assist you when those problems occur.

SUPPORT PERSONNEL/SYSTEMS

County Health Department: Many of your special needs students will need some medical and dental assistance. The county health facility is an excellent referral source for these problems.

Special Education: Through local boards of education, there are a variety of special education personnel available locally, regionally and from the State Department of Education. The vocational education administrator can obtain assistance from these specialists through the local superintendent's office.

Project SERVE: Project SERVE is a statewide effort to acquire materials and to cultivate expertise in providing vocational education to the disadvantaged. Project SERVE can be contacted by the area vocational-technical director or the vocational supervisor.

Vocational Rehabilitation: Vocational rehabilitation is a highly developed organization whose major focus is all dimensions (such as: training, diagnosing, job placement and counseling) of the handicapped population. Within that network is a vast pool of expertise. You can contact it through the area vocational rehabilitation counselor who calls on your school or through a designated school official such as the coordinator of student personnel services or Career Development Center personnel.

Office of Student Personnel Services: In the area vocational-technical school, this is the key group as far as students and student needs are concerned. They can provide a variety of services to you and to your students. Many of the contacts with community agencies have already been made by this group. That alone will save you much time.

Career Development Center: Each area vocational-technical school has a Career Development Center designed to meet the very special needs of incoming disadvantaged and handicapped students. The CDC staff is available to assist you with a wide range of services for the special needs student.

All the resource personnel previously listed are part of a team. The best results can be achieved by utilizing many possible resources. Do not hesitate to call the appropriate experts for additional assistance. Most of the service groups are funded to support your special needs students. If you do not use them, they fail in their mission and you also fail in yours.

INSTRUCTIONAL MANAGEMENT INFORMATION

INSTRUCTIONAL MANAGEMENT INFORMATION

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INSTRUCTIONAL MANAGEMENT INFORMATION INTRODUCTION

This section provides information and tools which should be helpful in making your program operate more efficiently.

STUDENT COMPETENCY RECORD INTRODUCTION

On the following pages, a records management tool, the Competency Record, is provided.

The Competency Record is the instrument for documenting individual student competency. This record should be filled out by you, the instructor, upon student mastery of a competency. Not only does the Competency Record serve as a progress indicator to you, but it can also be helpful to potential employers.

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Electromechanical Technology Core Curriculum

Awarded by

____

(School Name)

Student's Name ____________________ Dates of Attendance ____________

Quarters/Semesters Completed ____________ Clock Hours Enrolled ____________

Percentage of Program Completed ____________ Credit Hours Earned ____________

(School Emblem)

THIS DOCUMENT IS AN OFFICIAL STUDENT RECORD of skills attained in the occupational training program noted above.

CORE

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Electrical and Electronics Circuits		
A1 Identifying electrical/electronics parts	--	--
A2 Troubleshooting circuits	--	--
A3 Replacing faulty components	--	--
COMPETENCY AREA B: Servicing Electric Motors		
B1 Testing armature	--	--
B2 Testing field	--	--
B3 Troubleshooting motor circuitry	--	--
B4 Servicing and replacing bearings	--	--
B5 Installing and wiring electric motors	--	--
COMPETENCY AREA C: Servicing Generators		
C1 Testing armature	--	--
C2 Testing field	--	--
C3 Troubleshooting generator circuitry	--	--
C4 Servicing and replacing bearings	--	--
C5 Installing and wiring generators	--	--

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA D: Analyzing and Servicing Rectifiers		
D1 Testing rectifiers	--	--
D2 Replacing diodes	--	--
D3 Replacing full and half wave bridges	--	--
COMPETENCY AREA E: Analyzing and Servicing Filters		
E1 Testing filters and filter circuits	--	--
E2 Replacing capacitors	--	--
COMPETENCY AREA F: Analyzing and Servicing Electrical and Electronic Timers		
F1 Testing timer circuits	--	--
F2 Servicing timer circuits	--	--
COMPETENCY AREA G: Servicing Mechanical Transmissions		
G1 Analyzing transmission problems	--	--
G2 Repairing transmission problems	--	--
G3 Installing and adjusting transmissions	--	--

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA H: Servicing Pulley Systems		
H1 Analyzing pulley problems	--	--
H2 Servicing pulley systems	--	--
H3 Installing and adjusting pulley systems	--	--
COMPETENCY AREA I: Understanding Fluid Power		
I1 Explaining principles of hydraulics	--	--
I2 Explaining principles of pneumatics	--	--
I3 Reading hydraulic/pneumatic schematic diagrams	--	--
I4 Recognizing hydraulic/pneumatic basic components	--	--
COMPETENCY AREA J: Holding a Job		
J1 Obtaining a job	--	--
J2 Holding a job	--	--

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Air Conditioning and Refrigeration

Awarded by

____
(School Name)

Student's Name ____________________ Dates of Attendance ____________

Quarters/Semesters Completed ____________ Clock Hours Enrolled ____________

Percentage of Program Completed ____________ Credit Hours Earned ____________

(School Emblem)

THIS DOCUMENT IS AN OFFICIAL STUDENT RECORD of skills attained in the occupational training program noted above.

CONSUMER APPLICATION
Air Conditioning and Refrigeration

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Refrigeration Units		
A1 Installing refrigeration units		--
A2 Testing/repairing compressor units		--
A3 Recharging refrigeration units		--
A4 Testing/repairing electrical components		--
COMPETENCY AREA B: Servicing Air Conditioning Units		
B1 Installing air conditioning units		--
B2 Testing/repairing compressor units		--
B3 Recharging air conditioning units		--
B4 Installing wiring and ducting		--

BEST COPY AVAILABLE

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Residential Electrical Wiring

Awarded by

____
(School Name)

Student's Name ____________ Dates of Attendance ____________

Quarters/Semesters Completed ____________ Clock Hours Enrolled ____________

Percentage of Program Completed ____________ Credit Hours Earned ____________

(School Emblem)

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ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Installing/Servicing Residential Electrical Wiring		
A1 Installing wiring		--
A2 Installing service entrance		--
A3 Installing wall outlets		--
A4 Installing switches		--
A5 Wiring for major appliances		--
A6 Testing and repairing wiring and switches		--

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Major Appliances

Awarded by

____

(School Name)

Student's Name	________________	Dates of Attendance	__________
Quarters/Semesters Completed	__________	Clock Hours Enrolled	__________
Percentage of Program Completed	_______	Credit Hours Earned	__________

(School Emblem)

THIS DOCUMENT IS AN OFFICIAL STUDENT RECORD of skills attained in the occupational training program noted above.

CONSUMER APPLICATION
Major Appliances

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Electric Clothes Dryers		
A1 Installing wiring for electric dryer		--
A2 Testing electric clothes dryer		--
A3 Repairing/replacing parts of a dryer		--
A4 Installing air duct for dryers		--
COMPETENCY AREA B: Servicing Gas Clothes Dryers		
B1 Installing gas clothes dryer		--
B2 Testing gas clothes dryer		--
B3 Repairing/replacing parts of a dryer		--
B4 Installing gas pipes for a dryer		--
B5 Installing air duct for dryers		--
COMPETENCY AREA C: Servicing Clothes Washer		
C1 Installing plumbing and wiring for washer		--
C2 Testing/repairing electric motors		--
C3 Testing/repairing washer transmissions		--
C4 Testing/repairing water pumps		--
C5 Testing/repairing timer and control circuits		--

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA D: Servicing Electric Water Heaters		
D1 Installing water heaters		--
D2 Testing and repairing water heaters		--
D3 Installing water heater plumbing and wiring		--
COMPETENCY AREA E: Servicing Gas Water Heaters		
E1 Installing gas water heaters		--
E2 Testing and repairing water heaters		--
E3 Installing water heater plumbing and gas pipes		--
COMPETENCY AREA F: Servicing Trash Compactors		
F1 Installing trash compactors		--
F2 Testing/repairing compactor electric circuits		--
F3 Testing/repairing compactor motors		--
F4 Testing/repairing compactors sensors		--

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA G: Servicing Dishwashers		
G1 Installing dishwashers		--
G2 Installing plumbing and wiring for dishwashers		--
G3 Testing/repairing dishwasher electric circuits		--
G4 Testing/repairing dishwasher pumps		--
G5 Testing/repairing dishwasher heating elements		--
COMPETENCY AREA H: Servicing Electric Stove/Ovens		
H1 Installing electric stove/ovens		--
H2 Testing/repairing heating elements		--
H3 Installing electrical wiring for stove/ovens		--
H4 Testing/repairing thermostats and circuits		--
H5 Testing/repairing electrical controls and timers		

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA I: Servicing Gas Stove/Ovens		
I1 Installing gas stove/ovens		--
I2 Testing/repairing gas burner		--
I3 Installing gas pipe and wiring for stove/ovens		--
I4 Testing/repairing thermostats and circuits		--
I5 Testing/repairing electrical controls and timers		
COMPETENCY AREA J: Servicing Microwave Ovens		
J1 Testing/repairing electrical circuits		--
J2 Testing/repairing microprocessor		--
J3 Testing/repairing sensors and safety switches		--
J4 Replacing defective parts		
J5 Testing and replacing displays		

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Hydraulic & Pneumatics

Awarded by

____
(School Name)

Student's Name ______________ Dates of Attendance ______________

Quarters/Semesters Completed ______________ Clock Hours Enrolled ______________

Percentage of Program Completed ______________ Credit Hours Earned ______________

(School Emblem)

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INDUSTRIAL APPLICATION
Hydraulics and Pneumatics

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Hydraulic Systems		
A1 Analyzing hydraulic system problems	--	
A2 Servicing hydraulic systems	--	
A3 Installing and adjusting hydraulic pumps	--	
A4 Installing and adjusting hydraulic lines		
A5 Installing and adjusting hydraulic gauges and controls		
COMPETENCY AREA B: Servicing Pneumatic Systems		
B1 Analyzing pneumatic system problems	--	
B2 Servicing pneumatic systems	--	
B3 Installing and adjusting pneumatic pumps	--	
B4 Installing and adjusting pneumatic lines		
B5 Installing and adjusting pneumatic gauges and controls		

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Industrial Electricity

Awarded by

(School Name)

Student's Name ______________________ Dates of Attendance ______________

Quarters/Semesters Completed ______________ Clock Hours Enrolled ______________

Percentage of Program Completed ______________ Credit Hours Earned ______________

(School Emblem)

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ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Industrial Wiring		
A1 Installing service conduit	--	--
A2 Installing wiring	--	--
A3 Installing 480,208,210 three phase	--	--
A4 Installing a service entrance	--	--
COMPETENCY AREA B: Servicing Industrial Lighting and Machines		
B1 Installing fluorescent lights	--	--
B2 Installing branch circuits and controls	--	--
B3 Installing electric motors	--	--
B4 Installing circuits for welders and heaters	--	--
B5 Installing a service entrance	--	--
B6 Servicing industrial wiring and equipment	--	--
B7 Testing industrial wiring and equipment	--	--

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Computer Technology

Awarded by

____
(School Name)

Student's Name ____________________ Dates of Attendance ____________

Quarters/Semesters Completed ____________ Clock Hours Enrolled ____________

Percentage of Program Completed ____________ Credit Hours Earned ____________

(School Emblem)

THIS DOCUMENT IS AN OFFICIAL STUDENT RECORD of skills attained in the occupational training program noted above.

INDUSTRIAL APPLICATION
Computer Technology

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Installing Computers		
A1 Installing computer equipment	--	
A2 Installing computer peripherals	--	
A3 Testing and start up	--	
A4 Installing electrical and cooling components	--	
COMPETENCY AREA B: Servicing Computers		
B1 Testing computer CPU	--	
B2 Testing computer O/I boards	--	
B3 Testing computer memory	--	
B4 Replacing faulty parts	--	
B5 Testing and debugging software	--	

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Numerical Controls

Awarded by

____
(School Name)

Student's Name ______________ Dates of Attendance ______________

Quarters/Semesters Completed ______________ Clock Hours Enrolled ______________

Percentage of Program Completed ______________ Credit Hours Earned ______________

(School Emblem)

THIS DOCUMENT IS AN OFFICIAL STUDENT RECORD of skills attained in the occupational training program noted above.

INDUSTRIAL APPLICATION
Numerical Controls

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Numeric Controlled Machines		
A1 Testing computer operations	--	
A2 Testing interface circuits	--	
A3 Repairing faulty circuits	--	
A4 Testing machines sensing devices	--	
A5 Repairing/replacing sensors	--	
COMPETENCY AREA B: Installing Numeric Control Equipment		
B1 Installing computer control devices	--	
B2 Running start up tests	--	
B3 Installing and testing microprocessor	--	
B4 Debugging software	--	

FOR FIELD REVIEW ONLY

Student Competency Certification

in

Robotics

Awarded by

____

(School Name)

Student's Name ______________ Dates of Attendance ______________

Quarters/Semesters Completed ______________ Clock Hours Enrolled ______________

Percentage of Program Completed ______________ Credit Hours Earned ______________

(School Emblem)

THIS DOCUMENT IS AN OFFICIAL STUDENT RECORD of skills attained in the occupational training program noted above.

ELECTROMECHANICAL CLUSTER STUDENT COMPETENCIES

	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
COMPETENCY AREA A: Servicing Hydraulic Robots		
A1 Testing robot controllers	--	
A2 Repairing controller and interface	--	
A3 Servicing hydraulic actuators	--	
A4 Servicing hydraulic power supplies	--	
A5 Testing robot components	--	
A6 Repairing, replacing end of arm tooling	--	
COMPETENCY AREA B: Servicing Pneumatic Robots		
B1 Testing pneumatic robot controllers	--	
B2 Repairing/replacing controller and interface	--	
B3 Servicing pneumatic actuators	--	
B4 Servicing pneumatic power supplies	--	
B5 Testing pneumatic robot components	--	
B6 Repairing/replacing end of arm tools	--	

COMPETENCY AREA C: Installing Robots	INDUSTRIAL APPLICATION	CONSUMER APPLICATION
C1 Installing robot power supplies	--	
C2 Installing robot actuators	--	
C3 Testing start up procedure	--	
C4 Writing robot programs	--	

CRITERION-REFERENCED TESTING INTRODUCTION

This section provides information on criterion-referenced testing. Types of tests which can be used for criterion-referenced testing are included and examples of tests are also provided.

CRITERION-REFERENCED TESTING

INTRODUCTION

A criterion-referenced test (CRT) compares a student's performance with an established standard of performance. The criterion-referenced test should be criterion-referenced, valid, reliable, standardized and economical. The student should be tested relative to a predetermined criteria rather than to the performance of other students. The CRT is valid only if it is objective and all conditions for testing have been standardized for each student.

The criterion - referenced test items should be developed using the objectives already presented and restating them as questions or requests for performance of skills. The results of the CRT should be used to determine whether the student has attained an acceptable level of performance and/or whether the student is ready to proceed to the next performance objective. CRTs should be used throughout a training program to evaluate the performance objectives.

The types of tests which can be used include the following:

--written
--oral
--performance

Written Tests

The written test can be the most objective type of test in terms of scoring. Also, many students can be tested at the same time. Diagrams or illustrations can be used to support the tests. The only disadvantage with written tests is that they cannot measure the student's ability to perform a task. The principal use of written tests is to test the student's knowledge of the subject.

Several steps which can be used in developing a criterion-referenced test include the following:

1. Items should be leveled according to the type of learning they represent.
2. Try out the item by asking it of those who know the answer and new students who shouldn't know it.
3. Keep possible responses to the point to avoid confusion.
4. Each item should be independent of other items.
5. Each item should be at the appropriate reading level and be clearly stated.
6. Doublecheck to be sure the answer is correct.
7. Items should reflect and cover objectives and content taught.

Some types of written test items which can be used are multiple choice, completion and matching. Examples of each are shown below.

Matching

Fill in the blanks below by matching the definitions with the numbered items.

1. 100 milliamperes
2. Electric shock
3. 10 milliamperes
4. First aid
5. Accident

____a. 0.1 ampere
____b. Unplanned event
____c. Emergency care
____d. Jarring, shaking feeling
____e. Muscle paralysis

Completion

At about ______ amperes, the shock is usually fatal if it lasts for one second or more.

Multiple Choice

The unit of inductive reactance is

a. henry
b. ohm
c. Hertz
d. millihenry

Students can also be asked to identify parts of machinery, etc. through the use of diagrams and illustrations.

Oral Tests

Oral tests should be prepared in the same manner as written tests except that they will require an oral response. In oral testing, specific questions could be asked which would require short answers. Occasionally, it might be necessary for the student to demonstrate his/her knowledge. If the oral test questions are developed with an objective scoring system, they can be used as criterion tests.

Performance Tests

Performance tests are tests which require the student to perform specific tasks.

Performance tests can often be administered to several students at once if the testing procedure is set up in a rotation order. For example, three work stations could be provided so that each student involved is performing a different task at a separate station. Once finished, the student moves on to the next station and the next task. This method of testing decreases the amount of time the instructor would otherwise spend watching each student perform each task separately.

Some steps which are helpful in preparing performance tests include the following.

1. Specify the objectives to be measured.
2. Describe exactly what you wish to test.
3. Devise the test situation or problem.
4. Make a list of tools, equipment and materials needed for the test.
5. Prepare directions for administering the test.
6. Develop a scoring system for the test.
7. Choose the evaluation instrument to be used.
8. Prepare the evaluation instrument.
9. Review the test - prepare a plan to check for reliability and validity.

A sample page of instructions for a performance test is shown below.

PERFORMANCE TEST

ELECTRONICS - Unit 32-A

____
(Student Name)

Performance Test (C-9) - RC Circuits (1)

MATERIALS AND EQUIPMENT LIST:

Pencil and paper
Audio Oscillator
Capacitors - (1) 0.1 uF; (1) 1.0 uF
Resistors - (1) 10K; (1) Meg
Digital Voltmeter

OBJECTIVES:

You will connect series and parallel RC circuits, make measurements and analyze the data so that you can explain the circuit operation and/or answer pertinent questions. The objective is met when you perform the above ations within the time limits and with an accuracy of 100%.

INSTRUCTIONS:

This is a time performance test with three (3) positions for the test. You will be given 10 minutes for each position. All necessary equipment is located at each position.

When you have performed a procedure and the test indicates for you to "Call the instructor"; raise your hand immediately. An instructor will be available to evaluate your work to that point, and tell you to progress (as appropriate), with minimal loss of time.

Should you have any equipment problems, or questions AT ANY TIME; feel free to call the instructor immediately so that your time will not be wasted.

DO NOT START THE TEST UNTIL THE INSTRUCTOR INDICATES THAT YOU MAY BEGIN!

A sample page of a performance test is shown below.

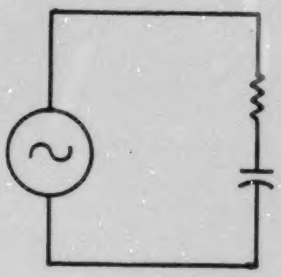
ELECTRONICS - Unit 32-A

____
(Student Name)

Performance Test (C-9) - RC Circuits (2)

POSITION I

1. Connect the circuit shown:



CALL THE INSTRUCTOR__________
(2 points)

2. Measure and record the following:

E_R = ________ V E_C = ________ V

CALL THE INSTRUCTOR__________
(2 points)

3. Calculate and record:

I_T = ________ mA

Z = ________ K ohms

X_C (using X_C formula, not Ohm's law) = ______ K ohms

4. If this same R and C were connected in parallel across the same source at the same frequency --- what would be the total current for the circuit? Calculate and record:

I_T = ________ mA

CALL THE INSTRUCTOR__________
(8 points)

TOTAL POINTS FOR THIS POSITION = 12

Three types of evaluation instruments are: the scorecard, the checklist and the rating scale. Examples of each are shown on this and the next two pages.

SCORECARD

Time Start ____
Time Stop ____
Grade ____

Major Block: Major Appliances - Diswashers

Major Block Objective: Diagnose present and potential problems in a dishwasher drain pump. Test, remove, repair or replace the drain pump.

Directions: Score yourself from 1 to the highest possible score. Ask the instructor to do the same. You must achieve the minimum score for each criteria for successful mastery of the objective.

PERFORMANCE INDICATORS	Std. Score	Min. Score	Self Score	Instr. Score
a. Proper sequencing of diagnostic steps	15	12		
b. Selection of correct tools and equipment	10	10		
c. Technique in use of tools and equipment	10	8		
d. Accuracy in locating malfunction	15	12		
e. Proper removal of component part(s)	10	7		
f. Accuracy in determining whether to rebuild or reject a malfunctioning part	10	10		
g. Proper installation of component part(s)	15	12		
h. Safety performance	15	15		
i. Correct testing pressures	10	8		
j. Time taken for complete job	10	7		
TOTALS	120	101		

Student Signature ____________________

Instructor Signature ____________________

CHECKLIST

Time Start ____
Time Stop ____
Grade ____

Major Block: Major Appliances - Dishwashers

Major Block Objective: Diagnose present and potential problems in a dishwasher drain pump. Test, remove, repair or replace the drain pump.

Directions: Place an (X) in the column that best describes the quality of your work. Ask your instructor to do the same.

PERFORMANCE INDICATORS	Student Check			Instructor Check		
	Poor	Avg.	Excel.	Poor	Avg.	Excel.
a. Is the diagnosis accurate?						
b. Are tools used properly?						
c. Are the proper tests applied and recorded?						
d. Is the visual inspection adequate?						
e. Are the proper techniques used in repairing/replacing components?						
f. Is the operational check in accordance with manufacturer's specifications?						
TOTALS						

Student Signature ________________________

Instructor Signature ________________________

RATING SCALE

Time Start ____
Time Stop ____
Grade ____

Major Block: Major Appliances - Dishwashers

Major Block Objective: Diagnose present and potential problems in a dishwasher drain pump. Test, remove, repair or replace the drain pump.

Directions: Place the rating you select in the last column on the right under "My Score". If the rating falls between 1 and 2, it will be evaluated as poor, 3 and 4 will be average, and 5 will be excellent. Use a number for the rating.

				My Score	Instr. Score
a.	Poor diagnostic skills	Average diagnostic skills	Excellent diagnostic skills		
b.	Poor visual interpretation of problem	Average visual interpretation of problem	Excellent visual interpretation of problem		
c.	Performs work in unsafe manner	May cause an accident to self or others	Performs work safely		
d.	Could not identify malfunction	Had difficult time identifying malfunction	Went straight to problem		
e.	Unable to change out component	Some difficulty in changing component	Easily changed out component		
			TOTALS		

Student Signature ______________________

Instructor Signature ______________________

Scott, Paul and James F. Watkins. "Criterion Referenced Testing or How Do We Know They Know." University of Georgia. Athens, GA.

Butler, F. Coit. *Instructional Systems Development for Vocational and Technical Training.* Educational Technology Publications. Englewood Cliffs, N.J. 1972.

CURRICULUM GUIDE SECTION REFERENCES INTRODUCTION

The following resource listing contains references used throughout the curriculum guide. All references are categorized by their prospective sections. Resource addresses for all references are also included.

CURRICULUM GUIDE SECTION REFERENCES

ADMISSIONS AND RECRUITMENT

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- "Electrical Wiring Residential - Utility Buildings-Service Areas" (S/T)
- "How Electric Motors Start and Run" (ST)

Bergwall
- "Basic AC Electricity for Heat, Ventilation and Air Conditioning - Part One" (FT)
- "Estimating the Job" (FS)
- "Finishing the Installation" (FT)
- "Installation for Signal Systems" (FS)
- "Low Voltage and Special Circuits" (FT)
- "Planning and Roughing In" (FT)
- "Receptacle and Ground Fault Interrupters" (ST)
- "Small Appliance Circuits" (FS)
- "Special Purpose Outlets" (FS)
- "Three-way and Four-way Switches" (FS)

Bobbs - Merrill
- "Fluid Power" (TR)

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- "Electrical Safety in the Shop" (FS)
- "House Wiring" (FS)
- "Making a Temporary Entrance" (FS)

Georgia
- "Applying Gas Fuel Combustion and Safety Principles" (ST)
- "Basic Copper Tubing Operations" (ST)
- "Charging the System" (ST)
- "Electrical Systems Operation and Troubleshooting" (ST)
- "Evacuating and Changing Refrigerators and Freezers" (ST)
- "Evacuating and Changing a Window Air Conditioner" (ST)

Georgia (cont.)
    "Gas Piping Principes" (ST)
    "Handling Refrigerants" (ST)
    "Identifying Residential Wiring Symbols and Designing Circuits" (ST)
    "Identifying Safe Working Conditions" (ST)
    "Identifying Tools" (ST)
    "Installation of a Window Unit" (ST)
    "Installing 115v Appliance Outlets" (ST)
    "Installing 230v Circuits and Outlets" (ST)
    "Installing Convenience Outlets" (ST)
    "Installing a Door Bell Circuit" (ST)
    "Installing Electric Ranges" (ST)
    "Installing Lighting Outlets" (ST)
    "Installing Refrigeration Accessories" (ST)
    "Installing and Servicing Pilot Ignition Devices" (ST)
    "Installing Service Entrance" (ST)
    "Installing Split and Switched Receptacles" (ST)
    "Installing Surface Unit and Hood" (ST)
    "Installing a Three-way Switch" (ST)
    "Installing and Using Refrigeration Manifold Gauges" (ST)
    "Maintaining Refrigeration Manifold Gauges" (ST)
    "Mechanical Systems Operation and Troubleshooting "(ST)
    "Troubleshooting Compressor Burnout in a Window Air Conditioner" (ST)
    "Troubleshooting Fans and Fan Motors" (ST)
    "Troubleshooting Refrigeration Cycle" (ST)
    "Troubleshooting a Thermostatic Expansion Valve" (ST)
    "Troubleshooting Window Air Conditioning Electrical System" (ST)
    "Troubleshooting Window Air Conditioner Refrigeration Cycle" (ST)
    "Understanding Basic Operation" (ST)
    "Understanding Basic Refrigeration Concepts" (ST)
    "Understanding the Basic Refrigeration Cycle" (ST)
    "Using Access Valves" (ST)

Hobar Productions
    "Electrical Connections and Current Control" (ST)
    "Electic Motors: Enclosures, Bearings and Mounting Methods" (ST)
    "Wiring a Switch and Lamp" (ST)

Long Filmslide Service
    "Transformers" (FS)

MAVCC
    "Hydraulics" (TR)

Parker-Hannifin
    "Fluid Power" (TR) (ST)

Singer Career Systems
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    "Electric Wire and Cable" (FT)
    "Electrical Boxes" (FT)
    "Electrical Service Entrance" (FT)

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RESOURCE ADDRESS

AAVIM (American Association
for Vocational Instruction
Materials)
160 Engineering Center
Athens, GA 30602

American Technical Society
5608 Stony Island Avenue
Chicago, IL 60637

Athens Area Vocational
Technical School
U.S. Highway 29 N.
Athens, GA 30601

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809 W. Detweiller Drive
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Peoria, IL 61615

Bergwall Productions, Inc.
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Garden City, NY 11530

Bobbs-Merrill Educational
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P.O. Box 7080
Indianapolis, IN 46206

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Farmingdale, NJ 07727

Bureau of Labor Statistics
U.S. Government Printing
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Washington, DC 20402

Career Aids, Inc.
8950 Lurline Avenue
Department T. 76
Chatsworth, CA 91311

Carrier Corporation
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Atlanta, GA 30321

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Helping Services
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Rochester, NY 14627

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Springfield, IL 62717

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Sidney, OH 45365

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Doolco, Inc.
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Dallas, TX 75226

Educational Technology
Publications
140 Sylvan Ave.
Englewood Cliffs, NJ 07632

E & L Instruments
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Derby, CT 06418

Florida State University
Career Education Center
Tallahassee, FL 32306

Georgia Office of Vocational
Education
Georgia Department of
Education
Twin Towers
Atlanta, GA 30334

George Washington University
Rehabilitation Research and
Training Center
Washington, DC 20006

Glencoe
866 Third Avenue
New York, NY 10022

The Goodheart-Willcox Company
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South Holland, IL 60473

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111 Fifth Ave., 12th Fl.
New York, NY 10003

Heath Company
Benton Harbor, MI 40922

Hobar Prductions
1234 Tiller Lane
St. Paul, MN 55112

Holt, Rinehart and Winston
383 Madison Avenue
New York, NY 10017

Howard W. Sams and Co., Inc.
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Industrial Press
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New York, NY 10157

Interstate Printers and
Publishing Company
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Somerset, NJ 08873

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Johnstown, PA 15902

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1515 West Sixth Avenue
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Association
470 Atlantic Avenue
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National Training Aids, Inc.
Manual Division "M"
P.O. Box 565
Norcross, GA 30091

North Carolina Department of
Education
Department of Public
Instruction
Raleigh, NC 27603

North Dakota Research
Coordination Unit
State Board of Vocational
Education
State Office Building
Bismarck, ND 58501

Office of Human Development
Rehabilitation Services and
Welfare
Washington, DC 20202

Ohio Department of Education
Columbus, OH 43216

Ohio State University
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Oklahoma State Department of
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17325 Euclid Ave.
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Radio Shack
A Division of Tandy
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Ft. Worth, TX 76102

Reston Publishing Co., Inc.
11480 Sunset Hills Road
Reston, VA 22090

Rutgers Vocational-Technical
Curriculum Laboratory
Rutgers University
Bldg. 4103-Kilmer Campus
New Brunswick, NJ 08903

Science Research Associates
155 N. Wacker Dr.
Chicago, IL 60606

Singer Career Systems
80 Commerce Drive
Rochester, NY 14623

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5101 Madison Rd.
Cincinnati, OH 45227

Standard Electric Time Company
89 Logan Street
Springfield, MA 01101

Stanley Works
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VDARE Service Bureau
P.O. Box 1945
Athens, GA 30603

Virginia Polytechnic Institute
and State University
Division of Vocational
Education
Blacksburg, VA 24060

Vocational Educational
Materials Center
The University of Georgia
Green Street
Athens, GA 30602

V'TECS
Southern Association of
Colleges and Schools
795 Peachtree Street, N.E.
Atlanta, GA 30365

Wisconsin Vocational Studies
Center
University of Wisconsin -
Madison
964 Educational Services Bldg.
1025 W. Johnson Street
Madison, WI 53706

GEORGIA PERFORMANCE STANDARDS REQUIRED FOR GRADUATION INTRODUCTION

On the following pages the Georgia Peformance Standards for Graduation are presented. The major thrust of these standards is that Georgia secondary schools should assist students in becoming competent in adult life role skills in addition to academic and vocational skills. This section details those adult life role skills and discusses various methods in which they can be implemented into vocational programs.

GEORGIA PERFORMANCE STANDARDS REQUIRED FOR GRADUATION

INTRODUCTION

The Georgia Board of Education Policy IHF, a plan for all Georgia secondary schools, was adopted in March 1980. With its passage, secondary schools have found it necessary to comply with the requirements set forth by the plan. The major thrust of Policy IHF is that Georgia secondary schools assist students in becoming competent in adult life role skills. As a result, instructors must teach those adult life role skills necessary to survive in our society in addition to their regular academic or vocational curriculum.

TOPICS COVERED IN THIS SECTION

1. What are adult life role skills?
2. How can a life role skill be integrated into vocational programs?

WHAT ARE ADULT LIFE ROLE SKILLS?*

Adult life role skills are those skills which are necessary for survival in our society. In Policy IHF, students are required to demonstrate competence in the adult life role skills of learner, individual, citizen, consumer and producer.

LEARNER

Citizens should demonstrate competence in the areas of reading, writing, mathematics, speaking and listening and problem solving.

A. Competency 1: Reading

Students will demonstrate competence by the ability to read, understand, interpret and use written materials in the context of academic problems, everyday tasks and employment activities.

Performance Objectives:

1. Distinguishes between fact and opinion.
2. Interprets semantic relationships.
3. Recognizes explicitly stated main ideas, details, sequence of events, and cause and effect relationships.
4. Follows directions.
5. Interprets figurative language.

6. Recognizes propaganda techniques.
7. Recognizes implicitly stated main ideas, details, sequence of events and cause and effect relationships.
8. Makes predictions, generalizations and comparisons.
9. Draws conclusions.
10. Interprets graphic information, instructions and labeling information, forms and applications, transportation information and occupational and career information.
11. Recognizes relevance of data.
12. Recognizes appropriate reference resources.
13. Locates information in reference materials.

B. Competency 2: Mathematics

Students will demonstrate competence by the ability to understand and employ basic mathematical concepts and operations in the context of academic problems, everyday tasks and employment activities.

Performance Objectives:

1. Translates from words to numerals and the reverse.
2. Orders fractions, decimals or percents.
3. Translates from decimals to percents and the reverse.
4. Translates from fractions to percents and the reverse.
5. Translates from fractions to decimals and the reverse.
6. Selects appropriate operations for a given problem situation.
7. Computes with whole numbers, fractions, decimals and percents.
8. Applies properties of operations.
9. Solves simple word problems.
10. Applies proportions.
11. Applies formulas.
12. Computes the mean and median.
13. Determines probabilities.
14. Organizes the data into tables, charts, and graphs.
15. Interprets data in the form of tables, charts and graphs.
16. Identifies customary or metric units to meassure lengths, area, volume, weight, time and temperature.
17. Applies customary or metric units of measurement to determine length, area, volume, weight, time and temperature.
18. Estimates numbers (results) using round numbers, with or without units of measurement.
19. Determines amounts of money.
20. Identifies sets of points using standard names.
21. Identifies geometric relations and properties.
22. Identifies points on cartesian coordinates.

C. Competency 3: Problem Solving

Students will demonstrate competence by the ability to evaluate, analyze and draw conclusions from situations presented in the context of academic problems, everyday tasks and employment activities.

1. Distinguishes between fact and opinion.
2. Recognizes main ideas, details, sequence of events, and cause and effect relationships.
3. Recognizes appropriate reference sources.
4. Locates information in reference materials.
5. Estimates outcomes, with or without units of measurements.
6. Draws conclusions.
7. Interprets non-graphic instructions, labels, forms and applications.
8. Recognizes relevance of data.
9. Organizes data into tables, charts and graphs.
10. Interprets data in the form of tables, charts and graphs.
11. Makes predictions, generalizations and comparisons.
12. Solves simple word problems.

D. Competency 4: Writing Students

Students will demonstrate competency by the ability to select, organize and compose written material in the context of academic problems, everyday tasks and employment activities. Indicators of writing include such skills as composing sentences, organizing information and writing paragraphs.

E. Competency 5: Speaking and Listening

Students will demonstrate competence by the ability to receive and transmit oral and aural communication in the context of academic problems, everyday tasks and employment activities. Indicators of speaking and listening may include interpreting aural communications, composing oral directions and questions and using formal and informal speaking styles.

INDIVIDUAL

Citizens should have the skills and understanding necessary to improve both physical and mental health. They should be able to use leisure time in a manner which is profitable and fulfilling. They should be able to establish a personal family role which is mutually beneficial to them and to members of their family.

A. Competency 1: Health and Safety

Performance Objectives:

A-1 Identifies causes, symptoms and methods of prevention and treatment for major non-communicable diseases.

A-2 Recognizes information about and identifies causes, symptoms and possible outcomes of the use of potentially harmful substances.

A-3 Demonstrates knowledge of principles and practices related to personal health.

A-4 Demonstrates knowledge of human reproduction, growth and development.

A-5 Demonstrates knowledge of mental health principles and practices.

A-6 Identifies causes, symptoms and methods of prevention and treatment for major communicable diseases.

A-7 Demonstrates knowledge of environmental factors and their influence on physical and mental health.

A-8 Demonstrates a knowledge of physical fitness principles and their relationship to health.

A-9 Demonstrates knowledge and skills related to sound nutrition principles and practices.

A-10 Demonstrates knowledge and skills related to safety principles and procedures.

A-11 Demonstrates knowledge of first aid principles and procedures.

B. Competency 2: Leisure Time Activities

Performance Objectives:

B-1 Demonstrates knowledge and identifies skills needed to participate in a variety of leisure activities.

B-2 Identifies community agencies and facilities which provide avocational, self-improvement, recreational and entertainment opportunities.

B-3 Demonstrates skills and knowledge associated with decisions related to personal and family travel and transportation.

B-4 Recognizes the contributions of leisure time activities to physical and mental health.

C. Competency 3: Family and Community Living

Performance Objectives:

C-1 Identifies knowledge and skills necessary for developing good relationships with family members and others.

C-2 Demonstrates knowledge related to family planning alternatives and identifies consequences of individuals' responsibilities for sexual activity.

C-3 Recognizes sound principles and practices related to parental responsibilities and child care.

C-4 Identifies the consequences of behaviors related to personal relationships and decision making.

CITIZEN

Citizens should have the skills and understanding to become responsible members of society, both using and contributing to society in an appropriate manner and interacting with the environment in a responsible way.

D. Competency 1: American Political and Economic Systems

Performance Objectives:

D-1 Demonstrates knowledge of the structure, function and relationships of local, state and national governments.

D-2 Recognizes the kinds, purposes and uses of taxes.

D-3 Identifies characteristics of and makes comparisons among major types of economic systems.

D-4 Identifies and compares economic problems of world societies.

D-5 Demonstrates knowledge of basic economic principles.

D-6 Demonstrates knowledge of human interdependence and the manner in which relations with other nations are developed and maintained.

D-7 Identifies contributions to the development of our country and culture by peoples from many nations and ethnic groups.

D-8 Identifies characteristics of and makes comparisons among major types of political systems.

E. Competency 2: Citizen Rights and Responsibilities

Performance Objectives:

E-1 Demonstrates knowledge and skills related to a citizen's legal rights and responsibilities.

E-2 Identifies the structure, purpose and process of the American legal system.

E-3 Demonstrates knowledge and skills needed to use and interpret basic legal documents.

E-4 Demonstrates knowledge of the causes of, solutions to, and prevention of environmental and societal problems.

F. Competency 3: Citizen Participation

Performance Objectives:

F-1 Demonstrates skills and knowledge needed to engage in and influence decision making in the American political system.

F-2 Identifies civic responsibilities of individuals and recognizes ways these responsibilities may be met.

PRODUCER

Citizens should have the skills and knowledge necessary to select and pursue careers which reflect personal interest and abilities. They should also have the skills needed to pursue new careers should a situation arise which dictates a change.

G. Competency 1: Career Decision Making

Performance Objectives:

G-1 Identifies realistic plans for attaining tentative career goals.

G-2 Matches individual characteristics, interests, and abilities with career characteristics and requirements.

G-3 Identifies steps involved in making a career choice.

G-4 Identifies and compares income benefits and expenses associated with various occupations.

G-5 Identifies factors which affect career and job satisfaction.

G-6 Recognizes factors beyond an individual's control that affect career choices.

G-7 Identifies sources of information and assistance for career decision making.

H. Competency 2: Job Acquisition and Retention

Performance Objectives:

H-1 Recognizes and uses sources of information and assistance for finding employment.

H-2 Identifies characteristics and behaviors necessary for job success and advancement.

H-3 Recognizes behaviors and skills necessary for a successful job interview.

H-4 Recognizes information and demonstrates skills needed to complete employment documents.

I. Competency 3: Career Mobility

Performance Objectives:

I-1 Identifies events or conditions that may necessitate career change.

I-2 Identifies opportunities for advancement in various occupations.

I-3 Identifies ways for re-training for job advancement or career change.

I-4 Identifies personal skills needed to prepare for and cope with career change.

CONSUMER

Citizens should have the skills and knowledge to be informed consumers in order to use available resources in an efficient and beneficial manner.

J. Competency 1: Personal Resource Management

Performance Objectives:

J-1 Demonstrates skills and knowledge related to developing and maintaining a personal budget.

J-2 Demonstrates skills and knowledge for preparing, checking and maintaining accurate financial forms and records.

J-3 Recognizes the effects of national economic conditions on individual money management.

J-4 Identifies sources of information and assistance with management of personal resources.

J-5 Demonstrates skills and knowledge required to seek out information and make decisions associated with the purchasing of goods and services.

J-6 Computes and compares costs of various alternatives related to housing.

J-7 Recognizes purposes, methods and information related to the use of savings and checking accounts, securing loans and investing.

J-8 Demonstrates knowledge related to selecting and analyzing insurance coverage.

J-9 Identifies purposes, methods and costs involved in credit purchases.

K. Competency 2: Consumer Rights and Responsibilities

Performance Objectives:

K-1 Identifies rights and responsibilities related to financial transactions among individuals, institutions and companies.

K-2 Recognizes an individual's rights and responsibilities in establishing and maintaining credit ratings.

K-3 Demonstrates skills and knowledge about the rights and responsibilities of a consumer making purchases.

K-4 Distinguishes between fact and opinion and recognizes various promotional tactics related to sales and advertising.

K-5 Interprets consumer protection information and documents related to purchases.

HOW CAN ADULT LIFE ROLE SKILLS BE INCORPORATED INTO VOCATIONAL PROGRAMS

As a vocational instructor, you are in an ideal position to reinforce adult life role skills. Activities which will assist students in achieving the performance objectives of the learner, individual, citizen, consumer and producer saturate vocational programs.

A complete listing of performance objectives for the adult life role skills was previously presented. The feasibility of covering every skill in your program is highly improbable. However, many adult life role skills are applicable to vocational programs in that they are directly related to different aspects of employment.

In a lab set up as a business, as illustrated in the EMPLOYABILITY SECTION, students must become aware of many aspects of a business. For example, students will need to know about items such as decision making, operating the economics of the business, legal responsibilities of the business and making financial transactions.

Other activities which could potentially be incorporated into vocational programs are provided below.

THE LEARNER

READING

Have the student:
--follow directions

- --interpret graphic information, instructions, and labeling information, forms and applications, transportation information and occupational and career information

MATHEMATICS

Have the student:
- --select appropriate operations for a specific problem situation
- --apply formulas

PROBLEM SOLVING

Have the student:
- --estimate outcomes, with or without units of measurements
- --distinguish between fact and opinion

WRITING

Have the student:
- --fill out job applications
- --compose a resume

SPEAKING AND LISTENING

Have the student:
- --compose oral directions
- --participate in a simulated interview

THE INDIVIDUAL

Have the student:
- --practice good grooming
- --know and understand safety procedures and principles

THE CITIZEN

Have the student:
- --become familiar with the kinds, purposes and uses of taxes
- --become famliar with legal rights (theirs and others)

THE PRODUCER

Have the student:
- --match personal interests and characteristics with a potentialjob
- --become familiar with skills necessary for finding and keeping a job

THE CONSUMER

Have the student:
- --become aware of rights and responsibilities of making purchases
- --become aware of the responsibilities related to making financial transactions

*Related Vocational Instruction and Competency Based Education. Atlanta, GA: Georgia Department of Education, April 1982.

LIVE WORK POLICY INTRODUCTION

One of the most meaningful training vehicles is customer repair work or live work requested by a customer and performed by a student. Such jobs pose serious problems in a public school shop, thereby requiring rigid regulations as indicated by the sample live work policy on the next two pages.

SAMPLE LIVE WORK POLICY

1. Live jobs must provide training for the student. This training can range from skill perfection to developing work habits or customer relation experiences.

2. All materials, parts and supplies used or required in such live work must be paid for by the customer at school cost. Under no circumstances can the school give away public funds or property through this type training. There shall be no cost on labor.

3. All purchases for items needed to do such production jobs must be processed through the school accounts. Under no circumstances should instructors place themselves in a vulnerable position by buying and reselling to customers of the school shop.

4. All monies received from customers must be receipted on an official school receipt and deposited in the school account.

5. All live work must be done by the student. The only time an instructor is to do a live job should be when it is used for demonstration purposes.

6. Under no circumstances shall the instructor or student receive money, rewards, benefits or in any way personally profit from such work, either directly or indirectly. To do so is in direct violation of state law which prohibits the use of public property for personal gain.

7. The following policies concerning the purchase of parts are intended to protect shop teachers from any possible inference that they, or students, are using public property for personal gain. This can only be done by conducting business through the school's accepted financial and accounting procedures. By doing so, adequate audit is always possible should the need arise.

    a. Teachers will be allowed to purchase parts, at school cost, for live work. However, a purchase order must be obtained and given to the vendor when the order is placed.

    b. Any items needed for the general operation of the shop programs or for instructional purposes must follow the usual procedure which includes administrative approval prior to ordering.

8. Customer Supplied Parts - For information concerning Customer Supplied Parts, check individual departmental policies.

9. What Work or Jobs May Be Accepted

   a. Individual instructors may only accept work from technical school staff and students. Other live work is subject to the approval of the Director.

   b. All live work must enhance the students' current training activities.

10. How Work or Jobs Will Be Received

Every live production job will be written up on the official school work order form at the time the job is accepted. This work order is to show what instructor accepted the job, the customer's name, address, telephone number, and the nature of the work to be performed.

11. Financial Responsibility

All work is on a cash and carry basis. So far as possible, the customer should be given a fair estimate of the possible expenditure before the work begins. After work has begun and investigation reveals the cost will exceed your estimate by $10 or more, the customer should be consulted and an O.K. obtained before proceeding. By all means, the customer is to understand he/she must pay all charges due before receiving the goods. Any work delivered without being paid for will become the instructor's liability.

12. Prices to Charge

   a. In cases where there are parts and materials used in performing the work, they are to be charged to the customer at school cost.

   b. In cases where there are no parts or materials, the instructor should charge the established flat rate to cover incidental items such as rags, solvent, tape, etc. Flat rate will be established annually during September after recommendation by the instructor and approval by the Director.

DAILY LESSON PLAN INTRODUCTION

A daily lesson plan, a tool developed to aid the instructor with planning instructional strategies, is presented on the following two pages. Unit guide sheets can be adapted to the daily lesson plan with minimum modifications.

DAILY LESSON PLAN*

NAME ____________________ DATE ______ PERIOD 1 2 3 4 5 6

COURSE TITLE AND NUMBER: ______________________________

UNIT TOPIC: ______________________________

COURSE CONTENT: ______________________________

____

____

____

DAILY PERFORMANCE OBJECTIVES FOR STUDENTS: Code levels of Objectives: K = Knowledge; C = Comprehension; Ap = Application; An = Analysis; S = Synthesis; E = Evaluation

____

The students will:

____

TEACHING STRATEGIES (Procedures)

- ___ check roll
- ___ introduce lesson
- ___ discuss previous lesson
- ___ give directions and explanation
- ___ board work
- ___ lecture
- ___ discussion
- ___ demonstration
- ___ role play
- ___ review student work
- ___ questioning
- ___ oral or written feedback
- ___ drill and practice
- ___ inquiry
- ___ problem solving
- ___ application activities
- ___ research
- ___ critical thinking

STUDENT ACTIVITIES

- ___ library work
- ___ board work
- ___ discussion
- ___ role play
- ___ simulation
- ___ definitions
- ___ notetaking
- ___ debate
- ___ research
- ___ seat work
- ___ valuing
- ___ small group
- ___ large group
- ___ individualized
- ___ independent study
- ________________
- ________________
- ________________
- ________________

TEACHING RESOURCES/ MATERIALS

- ___ textbook
- ___ worksheet
- ___ chalkboard
- ___ overhead projector
- ___ recorder
- ___ models
- ___ maps/globes
- ___ instruments
- ___ magazines/ periodicals
- ___ computer
- ___ videotape
- ___ audio cassette
- ________________
- ___ film ________
- ___ filmstrip _____
- ________________
- ___ games ________
- ________________
- ___ speaker ______
- ___ fieldtrip _____
- ___ ETV/ITV ______
- ___ equipment ____

EVALUATION PROCEDURES AND MATERIALS FOR LESSON:

___ pre-assessment (pretest)
___ progress checks:
  ___ homework
  ___ pop quiz
  ___ daily work
  ___ participation
  ___ teacher observation

___ unit/chapter test
___ quarter/semester exam
___ record of individual learner progress maintained in gradework and/or chart or file
___ Other ____________________
____
____

CONDUCT (List names of students exhibiting discipline problems which interfere with learning.)

ABSENCES (List of students absent.)

ASSIGNMENTS (classwork and homework, etc.)

TEACHER NOTES (description of activities, evaluation of lesson, problems, etc.)

REMEDIAL ACTIVITIES

ENRICHMENT ACTIVITIES

*Adapted from Columbia County School System

GLOSSARY

GLOSSARY

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GLOSSARY INTRODUCTION

The Glossary section is divided into two parts, TERMS - PART ONE and TERMS - PART TWO. Part One provides definitions for terms that are included in Curriculum Development Standards and Specifications, a document issued by the Vocational Division of the Georgia Department of Education. These terms relate to the broad area of vocational education. Part Two provides definitions for terms related to the curriculum guide but not included in Part One. You may desire to add more terms to the listings provided.

TERMS - PART ONE

AMPLITUDE - (When referring to recording) Refers to level of signal.

ARTICULATED PROGRAM - A curriculum program which provides for a continuous progression from secondary to postsecondary levels of training.

ASSEMBLE EDIT - (When referring to video recording) Refers to video tape editing where there is no continuous previously recorded "control track." Recording new audio and video information from one tape to another.

ASSIGNMENT INFORMATION SHEET (TEXT) - A sheet containing specific text page numbers for assignments from commercial texts and manuals used in a given program.

AUDIOVISUAL SUMMARY SHEET - A list of audiovisuals for a given program wherein information is given regarding the presentation titles, whether the presentations are stated-developed or commercial, state numbering for each presentation, source of commercial presentations and other related information.

BASIC SKILLS - "Skills which enable one to address effectively and efficiently the decisions and opportunities presented in a technological, urban, free society." (Policy IHF), the role of learner.

BLEED AREA - In printing, the area of image that will be trimmed after printing.

CAMERA READY - Indicates that the copy is either original typed or typeset copy, drawings, etc. or of equivalent quality as to contrast, cleanliness, sharpness, layout, etc, so that for printing, a high quality plate can be made, and for photographic purposes, material will photograph well.

COMPETENCY - A combination of related tasks, generally equates to an assignment received by a worker on the job. A cluster or grouping of related tasks. The ability (knowledge, skills and attitudes) to perform a group or cluster of related tasks required to complete a designated activity according to occupational standards.

COMPETENCY-BASED INSTRUCTION - Instruction which derives content from tasks performed in a given occupation/job and in which students are assessed for their performance on the basis of present occupational performance standards. Student performance and knowledge is individually evaluated against stated criteria, rather than against group norms.

COMPETENCY RECORD - A document or certificate which delineates the competencies that a student has acquired and proven by performance against industrial norms and to the satisfaction of the instructor and/or other officials signing the document. A record which is useful for articulation purposes, for providing information to potential employers, for tracking student progress, etc.

COMPLIANCE STATEMENT(S) - Statements included in state-developed curriculum documents which indicate that there is compliance with federal and other regulations related to non-discrimination, both in policy and in practice.

COURSE - Trainng wherein a grouping of competencies which have a common knowledge base, or are within a given domain are covered.

CRITERION-REFERENCED MEASURE - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective, a criterion-referenced measure as opposed to a "norm" based measure.

CRITERION-REFERENCED TEST - Sometimes referred to as criterion-referenced measure, final evaluation, final assessment, criterion exam, or checkout activity, one connotation is that it is a test designed to measure student competencies based on job or industrial standards. Another connotation is that it is an evaluation of student performance or knowledge of a task according to the conditions and standards stated in the performance objective.

D.O.T. CODE - Abbreviation for dictionary of occupational titles code. This document provides nine-digit codes identifying each occupation.

ESTABLISHING SHOT - (As used in videotaping) Refers to the opening shot in a given scene which establishes reference points within the scene for shots that follow.

EXIT POINT - A predetermined point within an instructional program in which a student may exit with the essential competencies for a specific job, usually defined in terms of D.O.T. and/or office of education (O.E.) codes.

FIELD REVIEW - Generally, a review of newly developed materials by those with industrial and/or instructional and content expertise for the purpose of evaluating the materials and providing useful feedback to the developers of the materials.

FIELD TEST - The evaluation of instructional materials in selected programs, under actual teaching conditions.

FIELD TEST PRODUCTS - Newly developed instructional materials which are in proper formats and are at the stage of development just prior to finalizing into finished, reproducible form, (i.e. to finalize only requires incorporating information, corrections and/or modifications indicated through field testing).

HORIZONTAL FORMAT - (When referring to 35mm slides) Refers to slides in which the picture content is such that the top and bottom of the picture are adjacent to the longer sides of the slide-frame "window" and the left and right sides of the picture are adjacent to the shorter sides of the slide-frame window.

IMAGE AREA - The area in printed or photographic materials that "should show" in the finished product. That part of the print, illustration, etc. which appears within the boundaries or limits of the printed page, projected slide, etc. usually, the image area has defined dimensional limits for any given medium.

INSERT EDIT - (As used in videotaping) Refers to an edit used if an existing control track is used from the existing "slave tape", and it is desired to retain existing audio or video on the slave tape and to insert audio only -- video only -- or any combination of these.

LIFE-COPING SKILLS - Those skills which enable a person to perform in the roles of individual, citizen, consumer and producer.

MASTERS - (When referring to printed or photographic materials) Refers to the printed or photographic materials which are used in order to reproduce or make copies. The original or best copies, from which copies are made.

MAJOR BLOCK - A complete set of training units or modules of learning covering a major segment or phase of the discipline being taught, for example, in automotive mechanics, power transmission would be considered a major block. In welding, oxyacetylene welding would be considered a major block or phase, etc.

MINOR BLOCK - A segment of training consisting of one or more units or modules of training which covers a major division or topic within a major block. For example, overhauling the differential would be considered a minor block within the major block entitled power transmission.

MIXED (OR MIXING) - (When referring to audio recording) Refers to combining two or more sound sources on to one track of the recording tape. For example, mixing voice "above" music (or music "under" voice). Mixing requires adjustment of the various sound sources to proper levels for best effect.

PACKAGE ENGINEERING - The process of planning packaging of instructional materials for consistency in packages, (for shipping purposes), so that for a given program all audiovisuals may be in package #1; all student materials in package #2 and instructor materials in package #3 -- For example, each set of instructional materials requires empirically determining the sizes of boxes needed, the number of boxes needed, and the most efficient packaging method. The process of determining these factors is package engineering.

PAGINATION - The sequencing of pages in printed documents to provide proper relationships between pages within the document.

PERFECT BOUND - A binding and cover for documents, generally over 100 pages in length, wherein a special gluing process and over-piece, "wrap-around" cover is used to bind and cover the book or document.

PERFORMANCE OBJECTIVE - Sometimes called behavioral objective unit objective or competency. An objective stated in such a way as to describe the conditions, the task(s) and the standards that the student must be able to operate under and achieve to verify mastery or attainment of the objective(s). A verbal description of the degree level of knowledge or skills to be acquired by the student for any given unit of training. It must also clarify what measurement criteria and conditions will exist to verify the student's achievement of the desired degree or level of learning.

PERFORMANCE TEST - Sometimes called a performance checklist, instructor checklist, or product checklist. A type of criterion-referenced test that requires the student to actually do a task, under the conditions and at the standard specified in the performance objective. A test entailing not only the ability to answer questions, but measuring the student's ability to operate, manipulate and/or perform a given task, as specified, as well.

PITCH - (When referring to typing) Refers to the number of characters per horizontal inch.

PLASTIC-WRAPPED - (When referring to curriculum materials developed by the state) Indicates a heavy "shrink-wrapped" stack of pages or printed materials, wrapped in plastic for protection and shipping purposes.

PROGRAM (OR TRAINING PROGRAM) - Generally, all of the training available for a given discipline of curriculum. The program may be considered to be comprised of all the student and instructor software, the facilities, the instructor, the equipment and all items and personnel required to carry out a training program for that discipline or curriculum, another meaning is, a planned series of courses.

QUALITY ASSURANCE TRANSMITTAL DOCUMENT - A document used by curriculum or instructional materials developers to affirm that appropriate quality control measures have been used in producing the products prior to being submitted to appropriate state personnel for review. This form shows what is being submitted; who has made the various quality control checks, and the dates upon which those checks were made.

SADDLE STITCHED - A type of document binding for documents, generally less than 100 pages in length, wherein staples are used to hold all the folded pages and the cover together, "at the fold" or center of the document.

SIGNAL-TO-NOISE-RATIO - (When referring to recording) Refers, for the purposes of this document, to the desired audio signal level compared to the unwanted signals on the tape, such as background hum, etc.

"SYNC" PULSES - (When referring to cassette tapes used in audio-visuals) Refers to the pulses put on a separate track from the narration and used for the purpose of controlling the advancement of visual media, such as slides, etc.

TASK- (OR UNIT) - A logically related set of actions required for the completion of a job objective, one basic operation, process, skill or knowledge element for which a person would normally be paid for knowing or doing in industry or employment. The smallest division of work in which a measurable output occurs, a logical and necessary step in the performance of a duty. Sometimes the term task is used in reference to a "unit" of training, or a given learning module or lesson.

TASK-COMPETENCY LISTING - A list which shows competencies versus the tasks of which each competency is comprised: Normally, mastery of two or more tasks are required in obtaining a given competency.

TASK LINKAGE - Refers to the project (or products of the project) that was conducted to identify the relationship between secondary occupational clusters and postsecondary specialized programs. The task was used as a common denominator.

TEXT LISTING SHEET - An information document supplied with a set of curriculum or instructional materials which delineates all the texts used in the program. The editions, publishers and authors are also given.

UNIT - One module of I.I. training materials, generally covering one learning task and programmed on one unit sheet.

UNIT SHEET - (FLOW CHART, OR LEARNING ACTIVITY SEQUENCE SHEET) - The guide sheet used by students to find out the sequence of learning activities they must follow to complete the unit they are studying. This sheet also defines the types of learning activities involved.

VCC NUMBERING SYSTEM - The state system of 7-digit numbers used for numbering audiovisuals which identifies the programs, the presentations within the programs and the slide number within presentations.

TERMS - PART TWO

A/Vs-AUDIOVISUALS - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

CHECKPOINT - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

CURRICULUM GUIDE - A document containing the objectives, content, organization and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

DUTY - One of the distinct major activities involved in the work performed. A compilation of related tasks.

"HANDS-ON" - Statement implying the student is physically involved in a learning activity.

INDIVIDUALIZED INSTRUCTION (I.I.) - A system of instruction allowing a student to progress at his/her fastest rate.

JOB - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

JOB SHEET - (OR OPERATIONS SHEET) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

LIVE WORK - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

OCCUPATIONAL CLUSTER - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

OCCUPATIONAL INVENTORY - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

O.E. - Refers to the U.S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

OPEN ENTRY - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

OPEN EXIT - Term meaning that a student may leave a program any time he/she completes occupational objectives.

PERFORMANCE GUIDE - A series of steps arranged in a sequence which when completed may result in the performance of a task. Also called teaching steps.

PROGRAM OBJECTIVE - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

SELF-PACED - Refers to a student moving through the prescribed training program at the fastest pace at which he/she can meaningfully learn.

SEQUENCING - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from simple to complex within groupings or blocks.

SOFTWARE - Written or printed materials, slides, filmstrips, tapes, etc. When used in conjunction with computers - means programs and accompanying documentation for computers. Software may be stored on cassette tapes, discs, etc.

STUDENT MANUAL - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures, job sheets, etc.

UNIT GUIDE - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to complete the task successfully.

V'TECS CATALOG - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures and related data. Organized by a job structure or career ladder within a domain of interest.

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs or activities receiving federal financial assistance.

Employees, students and the general public are hereby notified that the Georgia Department of Education does not discriminate in any educational programs or activities or in employment policies.

The following individuals have been designated as the employees responsible for coordinating the department's effort to implement this nondiscriminatory policy.

Title II - Ann Lary, Vocational Equity Coordinator
Title VI - Peyton Williams Jr., Associate Superintendent
of State Schools and Special Services
Title IX - Myra Tolbert, Coordinator
Section 504 - Jane Lee, Coordinator of Special Education

Inquiries concerning the application of Title II, Title VI, Title IX or Section 504 to the policies and practices of the department may be addressed to the persons listed above at the Georgia Department of Education, Twin Towers East, Atlanta 30334; to the Regional Office for Civil Rights, Atlanta 30323; or to the Director, Office for Civil Rights, Education Department, Washington, D.C. 20201.

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